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# *All About Guppies*

By

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*A Practical Science Book*

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*Designed and produced in the U.S.A.*

*To our wives,*
*who have so patiently tolerated*
*our mutual hobby, and, to their*
*great credit, actually encouraged*
*us in it.*

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## *Foreword*

This is the first popular book about guppies. It is meant to help the great majority of young and old guppy fanciers. It is not a scientific treatise. We hope it is not unscientific. A large technical literature about guppies has accumulated throughout the world. Most of the important reports can be found in the bibliography on pages 119 to 128 by anyone interested in strictly scientific aspects of our little fish. This is the first time in which all of the bibliography of the guppy has been brought together into a single book and none of it has been disregarded in preparing the text, but the scientific terms have been changed into language of the layman and free research results applied to useful, workable plans. Sometimes this has been difficult. There are a few spots where you may find a little study or re-reading necessary to interpret the facts, but this small effort should be worthwhile.

Nine hundred ninety-nine out of every one thousand guppy breeders are striving to produce more beautiful specimens. If we use what scientific knowledge we can glean along with practical wisdom, our aims can be accomplished ever so much quicker. And so we hope this book helps you to breed the most beautiful guppies in the world.

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Orange, Connecticut

**LEON F. WHITNEY, D.V.M.**
**PAUL HAHNEL**

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## CHAPTER I

# *The Guppy*

THE SUBJECT OF THIS BOOK IS A SMALL FRESH water fish, which in the wild state reaches a length, in females, of from one and a half to three inches; in males, two thirds of these lengths. The wild females are olive-grey, unattractively colored, each scale having a dark-lined edge; the males are highly, variously and brilliantly hued.

The guppy is one of the several kinds of fishes which gives birth to living young, a fact which makes it particularly interesting. Many a fish hobbyist has tried keeping and breeding several of the exotic species of aquarium fishes but in the end has abandoned all of the others and taken up the breeding of guppies because of their beauty, adaptability and other values.

Guppies are omnivorous surface feeders. The upturned mouth is sufficient evidence of that fact. It performs most useful services for mankind by eating the larval form of mosquitoes, adding materially to our comfort.

### HISTORY AND HABITAT

The scientific name for the guppy is *Lebistes reticulatus* (Peters). *Lebistes* is the name of the genus; *reticulatus* is the name of the species. Peters stands for the European discoverer. Wilhelm C. H. Peters found the fish in a collection brought to Germany from Venezuela in 1859. He described it as *Poecilia reticulata,* thinking, because of its resemblance to the other fishes of the *Poecilia* genus, it properly belonged there. In 1861, Filippi, a Spaniard, described the same species he found in a shipment of fishes from Barbados. Although he too noticed the resemblance to the *Poecilia* genus, he decided that they were a wholly new type and named them *Lebistes Poecilia.*

From Trinidad, an island off the coast of South America, came a slightly different guppy, sent to the British Museum in 1866 by the Rev. Robert John Lechmere Guppy, an Englishman by birth but of distant French ancestry. Those Trinidad guppies were at first thought to be a new species and were named by Albert K. Gunther, the Museum director, *Giradinus guppyi.*

To avoid this confusion of names, ichthyologists, in the interests of scientific accuracy, finally called it *Lebistes reticulatus.*

According to Fraser-Brunner, the first person to keep and breed the species in tanks was Captain J. A. M. Vipan, a collector for the British Museum. In a paper in the Zoological Societies Proceedings, Captain Vipan emphasized the value of the fish in destroying larvae. In 1909 Vipan interbred guppies from Barbados, Trinidad and Venezuela, thus demonstrating the inter-fertility of the several subspecies.

In Germany where tropical-fish keeping as a hobby flourished more than anywhere, the fish gained great popularity. Aquarists dropped the "i" from guppyi, and called it guppy (pronounced gup-pee, not goo-pee). Everywhere today it is known popularly by this name.

Anyone watching his guppies devouring mosquito larvae realizes why the British Colonial Office and agencies of other governments, upon learning its value, set about distributing large numbers of the little fishes here and there. At first the guppy was called the "million fish", probably because of its habit of reproducing so rapidly when food was abundant.

Shipment after shipment reached inhospitable environments where they perished, but guppies have now been established in a wild state in numerous parts of the world. There are claims from many areas of the tropics that the guppy always was a native. Mexican ichthyologists, finding the species wild, disclaim the theory of artificial introduction. It is unfortunate that a study was not made of the original habitat before distribution by man made this impossible. In the tropics the guppy is like Mark Twain's Yankee—ubiquitous.

Efforts have been made to populate areas where only the summer environment is equable for the guppy, usually without success. As a mosquito larvae destroyer, the *Gambusia* has been found to be more efficient in warmer areas of the world and minnows in the colder parts, so the guppy is no longer transferred in numbers as it once was.

Men of many nationalities have been concerned with the diminutive object of our interest. This fact exemplifies its appeal. Today, wherever fishes are kept, in far-flung lands over the whole earth's surface, by all of the races and nationalities of man, the guppy generally occupies an important, if not the most important position among the fishes which are fancied.

## FASCINATION OF GUPPIES AS A HOBBY

***Beauty.*** There is no more beautiful male fish extant than this living geni. At best, the males of any other species show but a few colors and great uniformity, every male being like every other. In a tank of guppies there are all shades of color, vivid, clear, pleasing, delicate. But you must use imagination and as you look at them imagine each is magnified. The beauty of the guppy, as contrasted with many species of aquarium fishes, is the beauty of a lovely piece of jewelry—a modern delicate wrist watch in contrast to an old-fashioned alarm clock. The female is not considered beautiful by many. True, the wild type lacks attractiveness, but today guppists are rapidly improving her until in some strains her tail and fins are luminously colored with gold, blue and purple. In these variations from the wild type—the gold, the albino—the females are beautiful fishes.

As in the case with all tropicals, proper lighting is required to bring out their beauty. Good eyesight enhances the appreciation of the delicate tones, yet even color-blind persons, who see reds and greens as shades of gray, can find in guppies all of the other colors and shades.

***Possibilities of Improvement.*** There are, fortunately, many persons who possess a talent which others unfortunately lack, the talent which drives them to want to improve living creatures. There are others who have an innate love of nature. For those with either one or a combination of these fortunate talents, the guppy offers a unique opportunity. Because of the great variety, a person, by selective breeding, can establish strains *ad infinitum.* There could be a separate, distinct strain for every guppy breeder in the world; but this we shall consider in greater detail when we observe some of the variations. No fish offers the possibility of fun and satisfaction which this little fellow presents.

***Education.*** What could afford finer lessons in nature than watching, day after day, the development of a whole generation within a few months: courtship, fertilization, gestation, birth, feeding, disease, enemies, life and death? There it is in all its beauty. But the education does not end with the aquarium's inhabitants. Before long you find yourself studying. Many who have never known what study was, have learned how greatly life can be enriched by that process. What are daphnia? Couldn't I grow my own? Where can I learn how? Where do tubefex worms live? One turns to books for the answers to innumerable questions. And thus one learns and learning opens additional avenues of life. For youngsters, the guppy furnishes lessons in life that they can comprehend.

***Small Expense Involved.*** The guppy hobby is available to everyone, young or old, rich or poor, elevator man or electrical engineer. A quart preserve jar, a goldfish bowl, a 2, 10, or 100 gallon tank. One of us who breeds exotic guppies uses only nineteen 10-gallon tanks, and another master breeder has approximately the same equipment. Yet another has four 20-gallon tanks in one room of his home and eight 3-gallon tanks which he maintains in his cellar. Thousands of breeders are happy with even one tank and a few auxiliary jars to use for maternity wards.

Nor does the equipment need to be expensive. Nearly everybody knows of someone who has an old aquarium in the attic or cellar which they will be glad to see in use. An advertisement in a newspaper will bring answers from those with equipment to sell. Both new and used tanks and accessories can be purchased from tropical fish stores.

All things considered, few hobbies cost so little unless one wants to spend a great deal and even, in that event, the cost of extra fine fishes will be the most expensive item.

***Time Required.*** The hobbiest can spend hours every day, or minutes. We demonstrated that 80 tanks can be cared for by using system, in fifteen minutes a day for six days, and four hours one day a week. If one does not use live algae cleaners, if one worries overly about keeping his glass sparkling, picks out snails by hand instead of using two little Cumberland turtles to eat them, watched each and every fish, one could spend half a day every day. Many, with leisure, prefer to do so, and find endless delight in the hobby.

***Feeding—A Simple Matter.*** With the introduction of complete rations in the form of dry or paste foods, feeding need take no more than a fraction of the time it formerly did when live food was used. Those who take great pleasure in watching fish eat may devote as much time to feeding as they wish. The point is, feeding need not take long. One can feed the guppies in 80 tanks in four minutes—a matter of three seconds per tank.

***Companionship.*** Nearly every lonely person feels better for having something visibly alive in the home. It gives a sense of companionship. True, one sees life within a different medium, and the fishes never become pets in the same capacity as a cat or a dog, but they are tangible, beautiful and living. What better hobby could be found for an aged person, an invalid or a shut-in?

***Encourages New Friendships.*** We recently attended a meeting of a tropical fish society with a membership of two hundred. Imagine the opportunity for new friendships in such an organization, formed about a common interest; in this case, guppies. You and your friends may form a guppy club, go on collecting trips for aquatic plants and fish food, study together, swap fishes and, in general, add to the richness of life.

***Of Great Value.*** Psychologists and philosophers are talking a great deal these days about values. Friendship has enormous value to some persons. Beliefs, even foolish beliefs and superstitions, have values. A strain of guppies, and sometimes even one, can have value to an owner out of all proportion to its real value. He would prefer to surrender money to parting with those fishes into which he has put thought and effort, and in some cases, even affection. One of us had a woman insist upon paying two dollars for a visit, hoping we could cure her ten-cent guppy, when he had offered to give her half a dozen really beautiful specimens. The ten-cent guppy represented a value to her in no way related to money.

### WHY THE GUPPY CAN FURNISH THESE ADVANTAGES

***A Live-Bearer.*** Many enthusiasts have been first attracted to the guppy because of its bearing living young. This is one of the species' most valuable characteristics.

***A Rapid Breeder.*** A female guppy, well fed, often has her first litter at the age of ninety days, which makes generations just that long. She has a new litter every twenty-eight days or thereabouts.

***Stand Inbreeding.*** Whereas most other species of fishes and mammals suffer greatly from inbreeding, become smaller, infertile or both, the guppy stands it remarkably well. Only by this process can we develop new strains or study heredity.

***Are Polygamous.*** One vigorous male can fertilize a large number of females, so it is not necessary to keep pairs of fishes. Improvement or fixing strains is thus more efficiently achieved.

***Have Wide Tolerance for Varied Environments.*** They breed in containers of almost any size and shape. The water in which guppies thrive need not be so constant or exact as to acidity, neutrality, or alkalinity as is required by many other fishes. They stand a wide range of temperature, sixty to one hundred degrees—a range of forty degrees—but there is an optimum, of course.

***Tolerate Irregular Feeding.*** Where some fishes require regularity in feeding, guppies can manage well when food is provided at irregular intervals. Being omnivorous, they eat algae, tiny water animals and plants, some invisible to us, and many eat the young of any female if they are hungry.

***Are Not Finnicky.*** The variety of food on which guppies can thrive is extremely wide. If there is an insufficient amount of one food, they eat another; dry food one meal, tubifex worms the next and then perhaps daphnia—they are not easily spoiled as are our household pets, and many other species of fishes.

***Are Not Timid.*** Once in a while a flighty female is found, but 99 out of every 100 guppies are unafraid.

***Subject to Few Diseases.*** For most of the few diseases the species falls heir to, we have remedies, if applied in time. And the diseases are few in number. Cancer, a curse in some species, is rare in guppies.

***Not Pugnacious.*** Large numbers of males, females, or both sexes may be maintained in peaceful harmony constantly. Once in a while a pair of females will show animosity and spar about but no damage is done and peace soon prevails. Sometimes half a dozen males will pursue a female in a pack with never a show of jealousy.

***Produces Frequent Mutations.*** Last, but not least, this tremendously important fact probably is the basic reason for the fish's popularity. We shall deal with this principle in detail in Chapter V.

## CHAPTER II

# *The Guppy's Anatomy*

WATER LIFE HAS TAKEN MANY FORMS: BONEless blobs of soft protoplasm, represented by the jellyfishes; fishes with backbones and skeletons and even with such highly developed appendages as wing-like fins, with which they sail over the waves. The guppy is one of the smaller of the infinitely varied species of the great fish family. It lives in tropical warm water, can stand brackish water, and as we have seen, it is a member of the smaller pike family.

The color of the guppy is due to color spots, microscopic in size, called melanophores, located in the skin. The number and arrangement of these color areas is what gives the great variation among all but the most inbred specimens.

Outwardly, the fish we see takes its form from the supporting skeleton. The vertebral column runs from its head to its tail and is made up of many separate tiny perforated bones called vertebrae. The head at its anterior end contains the brain case or cranium. The upper and lower jaws are formed of bones. Ribs are attached to the vertebrae and protect many of the vital organs just as they do in ourselves. Fins project from the body at various points. There are also a hip or pelvic girdle and a shoulder girdle which help support the fins. A bony plate called an *operculum,* one on each side, covers the gills.

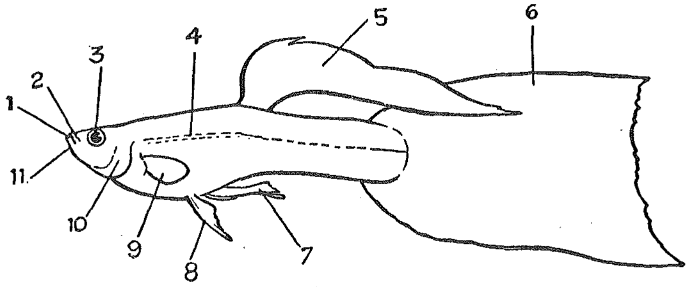
Chromatophores in guppy scales as seen by microscope.

The *dorsal* fin of the guppy is often the fish's crowning glory, standing as it does straight up from the ridgepole formed by the backbone, or lying supinely, and often extending, especially in exotic specimens, past the end of the tail. The pair of triangular fins at the sides are called *pectoral* fins, the tail is the *caudal* fin, the fins along the underside of the body are named for their positions. Thus we find the ventral pair called *pelvic* fins, and the single *anal* fin which contains double fin rays, joined so closely as to appear single.

Fins are supported by two kinds of fin rays. One is hard and unbranched, the other is soft and branched, with segments. Swimming is accomplished almost entirely by the movement of the fish's tail which propels by making a sort of figure eight. All the other fins help in guiding, elevating and descending. Watch any guppy and you will see he guides himself chiefly in a certain direction simply by turning his body.

### DIGESTIVE SYSTEM

Guppies have teeth in their jaws and in the roof of their mouth as well. In the mouth there is a tongue. Behind the tongue is the pharynx and on each side of it we find gill slits which allow water to pass into the gill chamber. Leading from the pharynx to the voluminous stomach is a short gullet or esophagus. From the stomach the intestine moves food, being digested, in a curved route to the anal opening just in front of the anal fin.

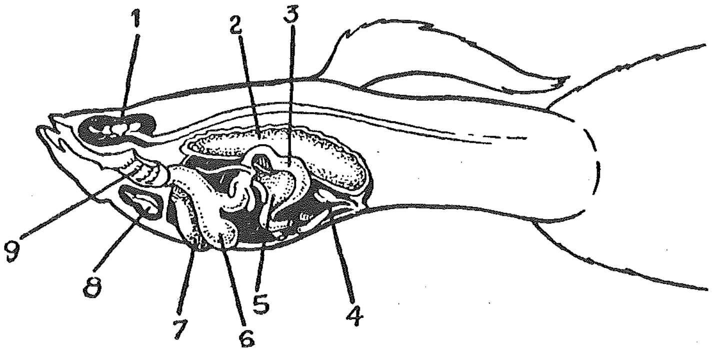


External parts of male guppy. (1) mouth, (2) nostril, (3) eye, (4) lateral line, (5) dorsal fin, (6) caudal fin or tail, (7) gonopodium (modified anal fin), (8) ventral fin, (9) pectoral fin, (10) operculum covering gills, (11) chin.

The guppy has a liver which manufactures bile for digestion and a spleen which helps purify the blood. Digestion is rapid, as witnessed by the large amount of food which can be handled by a guppy in a day.

### CIRCULATORY SYSTEM

The heart is quite different from that of the mammal. It has two compartments instead of four, an auricle and a ventricle. Blood is forced from the ventricle, when it contracts, to the gills where it picks up oxygen and gives up carbon dioxide. This aerated blood is carried by a dorsal artery—which divides into smaller and smaller vessels—to all the body. The blood in the capillaries gives off oxygen and picks up carbon dioxide and waste which are eventually carried back to the heart via veins. Besides the veins, other tubes, called lymph vessels, help carry the blood from the capillaries to the heart where it is again pumped to the gills.



Internal organs of the guppy. (1) brain, (2) air bladder, (3) intestine, (4) spermaries, (5) fat mass, (6) stomach, (7) liver, (8) heart, (9) gills. Kidneys (not shown) lie above air bladder surrounded by tissue.

Gills which serve as lungs, because of their exposed position, are subject to diseases. Each gill consists of a bony arch which has on its front surface teeth-like structures called gill rakers and, on its rear or posterior surface, gill filaments which are always bathed by a stream of water passing from the mouth out beneath the operculum.

### THE AIR BLADDER

A guppy maintains its balance and position in the water by the presence of an air bladder in its body cavity. Many blood vessels line the bladder wall and help maintain the gaseous content, regulating the amount of oxygen so that the air bladder helps to furnish a storage reservoir for air as well as acting as an organ of maintenance of volume to assure the fish's replacing an equal weight of water. Experiments indicate that the gas in the swim bladder contains a higher percentage of carbon dioxide than does normal atmosphere.

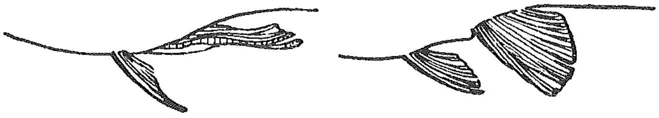
### REPRODUCTIVE SYSTEM

An egg-laying species of fish is called *oviparous.* One which gives birth to young, as mammals do, is called *viviparous.* But one which incubates a lot of eggs within the body of the mother and seemingly gives birth to them, is called *ovoviviparous.* The ovary is lined with germinal epithelium—tiny cells which divide and give rise to descendants. After further division and development, they become eggs, but not until they have acquired a yolk in the process. Young from such species are incubated within the mother from the food within the egg and not food taken from the mother's uterus via a placenta. The young obtain their oxygen and give off waste gases by the close association of tiny capillaries in walls of the follicles in which they develop, with the veinules (tiny veins) in the mother's reproductive tract.

A short passage conveys the tiny developed embryos, as the young are called, up to the moment of birth, to the urogenital pore whence they seem to uncoil and dart away to the safety of foliage or lie motionless on the sand or gravel of the bottom. Their first movements nearly always carry them downward and they rest for some time before becoming active. In a tank, they stay in small schools away from the larger fishes for many days.

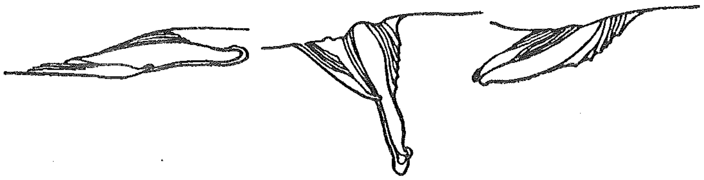
The male guppy has, in common with a few other livebearing fish, a gonopodium. At birth, the anal fin of the male guppy appears much like that of the female. As he grows, the fin becomes gradually modified so that in a resting stage, it appears narrow and somewhat longer than that of the female. The position of the attachment of the fin to the body is also different in the two sexes, the male fin moving gradually forward day by day as the fish ages.

When completely developed, the nine fin rays are crowded together. On the end of the longest ray, the third, we find a hood with a backward pointing hook. This hood folds over the gonopodium. There is no hollow tube in the gonopodium as so many erroneously believe.



Comparison of male and female ventral and anal fins.

The gonopodium is located just behind the urogenital pore. In front of that pore are two pelvic fins, quite different from those in the female. Fertilization is accomplished by the three modified fins all swinging forward together and possibly touching momentarily, thus making a temporary tube through which the male hereditary elements are transmitted to the female.



Construction of gonopodium and how it meshes with ventral fins to form male organ of insemination.

In the male, the organs in which the germ plasm is stored and in which the spermatozoa are manufactured are called spermaries (in the mammal they are called testes or testicles). A short passage connects the spermaries with the urogenital opening. Spermatogenesis, as the maturing of the sperm from the germ plasm is called, differs somewhat from the process in mammals. The spermaries are filled with tissue composed of basic germ plasm cells (primordial sex cells). All the time, by the process of division, these cells are producing more of their kind. It was once thought that these cells wear out because of exhaustion, but transplantation experiments in mammals indicate that the germ plasm is immortal and only seems to wear out because the fish or animal who is their custodian ages.

The first cells produced by the primordial sex cells are called *spermocytes.* These change again into cells with tails which propel them and are called *spermatozoa* or *sperm* for short, and lie packed together in cell spaces called *spermatocysts.* In mammals the sperm lie in tubules with heads toward the outside and tails in. They move along the *vas deferens,* as the tube is called, in a mass. But in male guppies, they stay in groups encased within a globe called a *spermatophore.* Not masses of loose sperm, as in the case of mammals, but a line of *spermatophores* move along the *sperm duct* to the area closest to the outside, called the *emmectory.*

As we have already observed, the doubled anal fin of the male guppy is modified to be capable of foreward movement and to form a transmission tube when in this position. The whole action of the mechanical part of the transferral of the sperm is done so rapidly that no human eye can witness it. The magician who fools us by rapid manipulation of cards is slow as molasses compared with the movements of the male guppy. The *spermatophores* are popped into the female's genital pore and once inside are moved into the oviduct.

The photograph shown opposite page 23 illustrates the process very well.

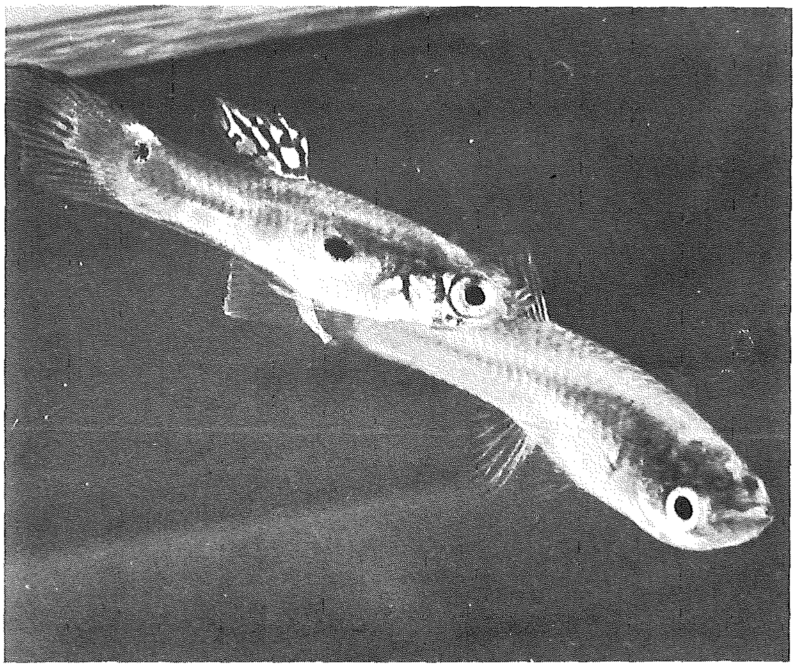
The female manufactures eggs or ova. The tube which receives the *spermatophores* of the male and conducts them to the ovary is called the *oviduct,* when actually it is no such thing, for ovi-duct means egg duct and the guppy does not lay eggs.

In the oviduct the sperm are released from the membrane which holds them together. Secretions from the female are thought to weaken the membrane and allow the sperm to escape. They move into folds of the organ and wait for eggs to be formed.

The formation of the egg is not unlike that of the sperm. Some of the primordial cells divide, their progeny divide and form eggs. The number of eggs formed is the deciding factor in the number of offspring spawned; there are thousands of sperm for every single egg. Nature is frugal with eggs and extremely lavish with sperm. In one ejaculation from most male mammals there are ten million or more sperm, but in the case of guppies, we do not know how many are received by the female. The number must be very large because one insemination is capable of producing litter after litter for several months—perhaps as many as eight. And in mammals the sperm live but a few days in the reproductive tract of the female.

Fertilization is a most interesting phenomenon in guppies. The sperm enter the ovary where they wait for the ripening of the first batch of eggs. Another crop of eggs does not mature to the point of union with the waiting sperm until the last lot has left the body of the fish as live fry. After birth has taken place, the new eggs develop rapidly and are fertilized by waiting sperm. One report indicates that sperm can wait, dormant in the female's body, for eight months, and still be able to fertilize.

One of the most remarkable facts about the female is her ability to hold so many of her young, both before and after they are born. Before—even being as distended as she appears, how can seventy-five babies, let us say, be packed away along with their embryonal envelopes in so small a place? And even as interesting is the question of how she can hold so many in her stomach. We have known a female guppy to eat all of her young just as rapidly as she gave birth to them. Part of this is fear and part protection of the young. If a female is having young quietly—has a swarm around her—and she is disturbed, the young will be missing shortly afterwards. But the reason for eating the young is principally the hunger of the mother.



One most important problem which we have studied is that of determining whether a female, once fertilized, can be fertilized by a second or third male. This experiment was done by mating a gold female to a gold male. While she was giving birth to her golden young, several young natural-colored males were placed in the tank. In her next litter there were no golds; the sperm of the natural-colored males had done the fertilizing. The same experiment was repeated many times with identical results. Then it was tried with albino females with again the same results.

The conclusion seems to indicate that if a female is bred to one male, he can provide sperm for several litters. But, if at about the time of giving birth, the female is mated to another male, the fresher sperm are more likely to fertilize the next batch of eggs. This has practical value in breeding.

The gestation period—the time between fertilization and birth—is 22-24 days. Broods are produced, under optimum conditions, every 27-30 days. The five or six days difference is accounted for by the time necessary for the development of the eggs to a fertilizable condition.

At the age of 30-35 days the sexes can be distinguished by the development of larger body of the female and her "gravid spot" which males do not show. The male begins to show the developing gonopodium. The distinctive color markings or black spots begin to develop where they can be seen at about the fortieth day onward. Tail colors show, as early as twenty-eight days in the fast grown specimen. Great strain differences exist in this regard, some strains maturing two weeks earlier than others. Rapidly grown males have been known to have the start of color development by twenty-eight days of age. The characteristic black, red and yellow pigments appear to depend upon hormones produced in the testes and this is important to realize. The female hormones repress the colors which the males show. Females subjected to male hormones develop male characteristics.

Immature females may receive sperm of mature males and carry it until they are mature. Therefore it is essential to remove all the adult males from a tank of fry, or remove the fry to another tank soon after birth.

The virgin female guppy has a period, once every 4-6 days, when she will accept the male. This fact has been ascertained by watching many and noting that each one, when the temperature was about 80° F, assumed an oblique position in the water. In cold water she seldom, if ever, changes her position although males continue to pursue her even though there may have been no outwardly observable sexual rhythm or possibly no inward changes either. All available evidence tells us that guppies are more prolific in warm tropical water.

There is evidence that the male may produce a substance which, a day after he is introduced into a tank, will tend to make a female assume the oblique position even in water colder than 80° F. Some breeders contend that they have better results with shy breeding females when they use a large number of males for one female. Possibly it is because of this unknown male-produced substance that is then more abundant that such females tend to become fecund.

## THE NERVOUS SYSTEM

Guppies have all the ordinary *senses* and possibly others not possessed by mammals. The brain is the main organ of perception; a spinal cord of nerves runs through the vertebrae. Guppies *smell* through nervous connections of the brain via olfactory tracts not connected with the respiratory system; they *hear* through two closed cavities on opposite sides of the head containing ear stones (otoliths) which convey sound vibrations; they *feel* through nerve connections in the skin and *lateral line* organs, unique in fishes; they *taste* their food; they *balance*, possibly by their otoliths.

Guppies have furnished worthwhile evidence to neurologists in nerve regeneration. It is possible to cut through the whole spinal cord and have it regenerate in a short time—in some as early as the third day following the operation.

## EXCRETORY SYSTEM

Kidneys filter blood and remove waste which is carried to the bladder by ureters. Both kidney and bladder are small organs. The bladder discharges through the urogenital pore, just behind the anus.

Blood carries waste gases to the gills where they are given off into the water.

CHAPTER III

# *Physical Equipment Needed*

WHAT DOES ONE NEED IN THE WAY OF EQUIPment to raise guppies? Very little. It can be done with assurances of success in a few gallon preserve jars, some gravel, plants and a net. Or it can be done better and more efficiently with more elaborate equipment. After knowing many guppy fanciers and studying their equipment, I tried to work out as efficient a guppy room as I could and this is the equipment I decided upon. Now, after several years of using it, I can see few ways to improve it.

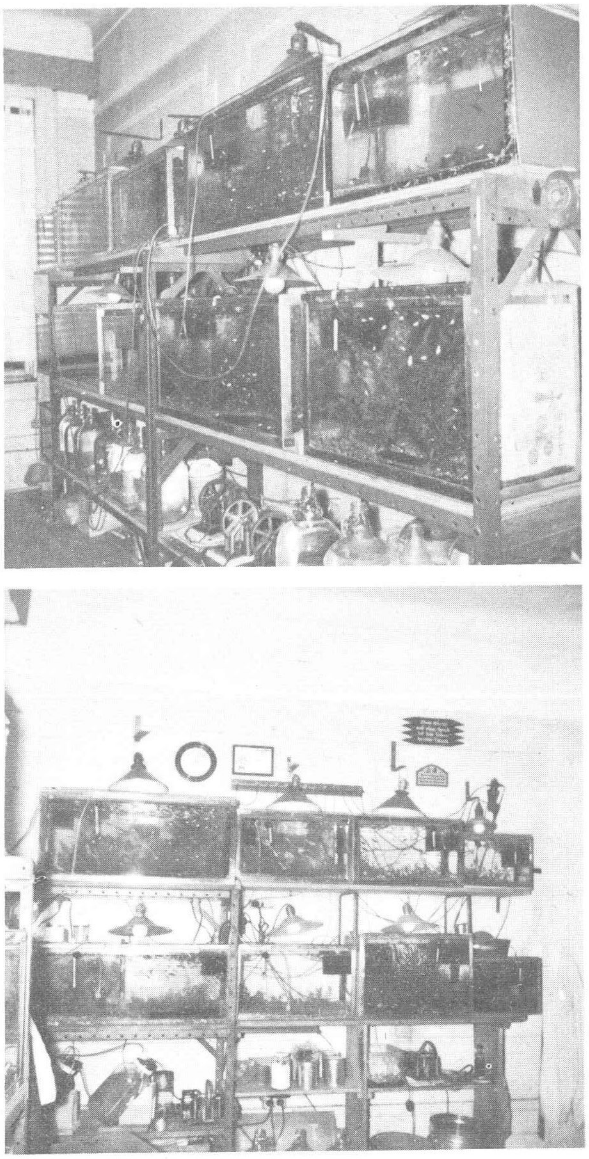
***Tanks.*** Our own tanks are chiefly 10 and 15 gallon sizes. One, as may be seen in the illustrations uses 2 and 10-gallon tanks, the other 10 and 15-gallon sizes.

One uses an automobile air compressor, the other several small pumps. We have tried fluorescent lighting and incandescent. Plants grow differently under various kinds of lights. By the time you read this, both of us will be using incandescent exclusively—a 35 watt bulb in a reflector over each large tank.

A fancier maintaining but one strain can do wonderfully well with six or eight tanks. A beginner can raise fine guppies in a few large mayonnaise jars (obtained through the courtesy of a restaurant owner), and successfully keep his fishes, provided he has some means of controlling the temperature and does not try to keep more fishes than his jars can accommodate without artificial aeration.

Few are long content with such slim equipment. As the number of guppies increases the need for more elaborate equipment increases too. The gadgets in aquarium supply companies entice one to want to own them. Catalogues with their interesting assortments of useful things, expensive plants, remedies, pumps, filters, breeding traps are hard to put down without sending an order for something. The hobbiest steps next to a large tank. It can be of stainless steel or black mottled frame. But it must have an automatic means of temperature control. This involves a heater and thermostat or a single tube with both elements inside. An overhead light in a reflector shows off the fishes to excellent advantage.

***Water*** is a big problem. Where one has a crystal-clear fast-running brook, and the water has been found agreeable to the guppies, it is usually the finest kind of water. City water from storage reservoirs is fine after the chlorine is out. City water from artesian wells often kills fishes quickly. Spring water is not always safe nor is the water from brooks draining mineral deposits. One expert says that water in which nitella grows and thrives is suitable and this is probably an excellent test. It is well worth trying. Some fanciers maintain glass-lined storage tanks which they fill with chlorinated city water and store until the chlorine has left it,



The entire Hahnel guppy breeding equipment in which the world's finest guppies are produced.

when it is run directly into the tanks to replace water removed by siphoning. Never put guppies into water that has been muddied with silty clay. As little as 2 parts in 100 can cause asphyxiation in two hours by coating the gills with silt. The guppies come to the surface, gulp air, swim on one side as evidence of their plight.

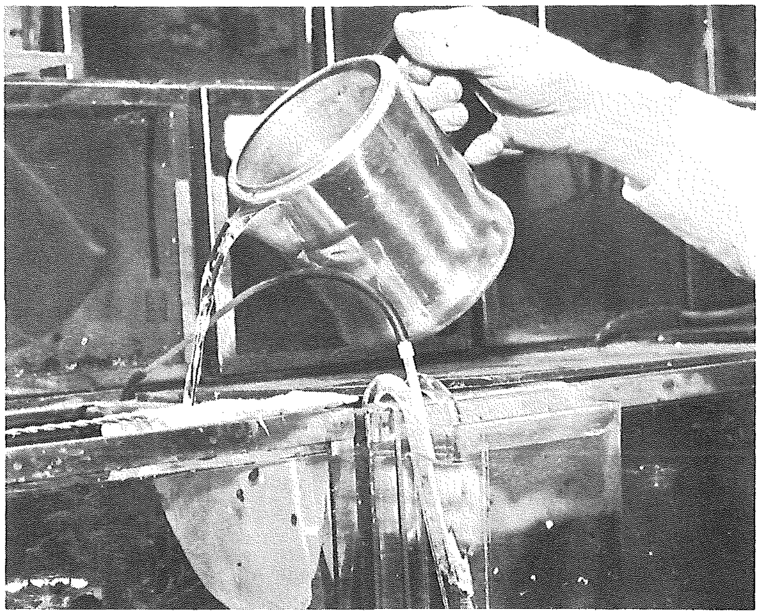
It is very possible that in their native environment guppies do not breed abundantly all the year around. Their reproductive habits are probably largely governed by their food supply and the condition of the water. In the dry seasons there is less new water moving in the streams and ponds where they live. Water becomes stagnant at times. In the wet seasons, fresh water, much of it rain—practically distilled water—refreshes the guppies' environment and puts new life into the little fish. And as the water pours in, food comes with it too.

How many aquarists refresh their guppies with new water added to the older conditioned medium? If your guppies are not doing well try this treatment and watch their resurgence from a state of torpor. In short, the poor little guppies are waiting all year around for the rainy season, but that season never comes.

*Adding water to a tank.* If you pour water directly into a well-planted tank, you may wash out the plants, produce deep pits in the gravel and generally roil the water. This may be avoided in several ways: (1) Cup one hand and hold it below the surface of the water, pouring the water into your hand. (2) Place one net inside another, submerge them and pour into the nets. (3) Arrange a watering can with a piece of cloth, circling a roll of mosquito netting six inches in length, sewed in place and attached to the spout of the can. Immerse the cloth-covered roll of netting as you pour and there will be little disturbance to the tank.

When you lose that crystal-clear look to the water of a tank, you may miss many facts that are highly necessary for you to observe. For the cloudiness which masks these details there are a number of causes.

In any tank there are materials of several sorts, such as uneaten food, fish feces, plant debris, dirt in the water, soil from feeding worms and so forth. Instead of all this lying at the front of the tank from where it is normally siphoned off, you see it moving about in the water. Such a condition is brought about by the aeration—the movement produced in the water by the air bubbles moving upward. This is an easy condition to remedy for one needs only a filter. But do not remove the aerator; leave it undisturbed so it will continue to agitate the water. Use a filter in addition to it and your tank water will become crystal-clear.


By pouring water into one very fine mesh net or into two nets, one inside the other, there will be no damage to the plants in the tank.

Another way to clean such a tank is by shutting off the air completely until the material settles when you can then siphon it off and add new water.

The Whitney guppy room where guppy research is conducted. Air is supplied by a compressor in the garage. The large concrete tank in the center is used for growing daphnia.

Bacterial clouding is another matter. When it occurs it generally means that you are overfeeding. Most, but not all, bacterial clouds disappear quickly when an antibiotic—penicillin, aureomycin or terramycin—is added to the water.

Feeding white worms and some of their food, or micro worms and some of their food, will add enough food for bacterial growth and produce a heavy cloud in the water. If an antibiotic will not clear it, drain the water and replace it.

The problem of acidity and alkalinity, a value measured in pH, is easily controlled. The yellow impregnated paper, which comes in narrow rolls and can be had in any fish supply store, accurately measures pH. Guppies thrive best at about 7. on the scale. This represents neutral. Test kits using liquid indicators are also available but more expensive and, because the liquids may be stale, not as accurate, and not as simple to use as the paper indicator.

If you find the water to be too acid, add a small amount of bicarbonate of soda, if too alkaline add a little bi-sodium phosphate. The amounts to be added depend on the acidity or alkalinity and the size of your tank. For a two gallon tank a pinch of either chemical may be enough; for a 10 gallon, a quarter of a teaspoonful. You can tell by taking a reading with your pH indicator after the chemicals are dissolved and well mixed with the water.

Algae are tiny plants which grow in water and produce various effects. A microscope will take you into a whole new world if you use it to study what to most persons is a green color in the water. Biologists say that algae were the first plants; that all other forms of vegetation, including trees, evolved from so humble a beginning. Some algae are large —the shaggy brown masses one sees clinging to rocks at low tide along the coast. You can see violet colored, red, blue-green or just plain green algae. "Frog spittle" which is formed in stagnant fresh water is a form of it. The variety in the world of algae is bewildering. All algae contain chlorophyll and have nucleii in their cells. It is the chlorophyll which makes them different from bacteria or fungi. Blue-green algae, having no nucleii, are an exception and merit a separate classification. The important thing to remember is that algae use up large amounts of carbon dioxide.

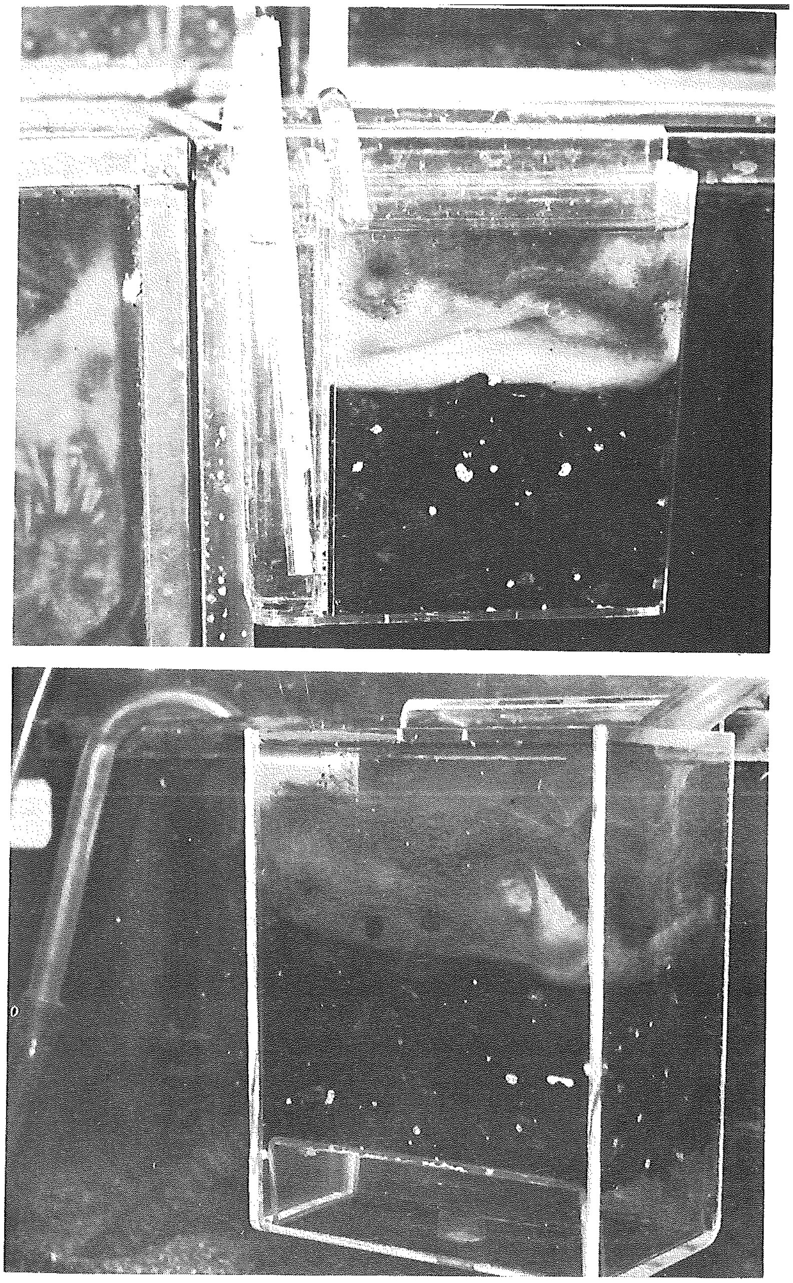
and many species are actually helpful to the tank. Your microscope can show you some which cling together and coat plants, glass and gravel; some which move about like the form so well known to students of botany—*Euglena viridis,* with its spindle-shaped body, lack of rigid cellulose wall so it can writhe like a worm, its red eye spot and flagellum and swimming ability. Some algae may poison the water. Studies show that dying and decomposing blue-green algae will kill the fishes in a very short time. Even in lakes they have been known to destroy tons of fishes.

Some forms remain together in tiny colonies, and if anyone wishes, he can learn a great deal about the theory of evolution simply by studying algae. Every guppiest needs to know about algae, if for no other reason than to know how to control them.

Algae cannot multiply in darkness. Many die if all bright light is shut off. Killing them in this way, however, may produce an ill effect on the fishes. It is better to remove the tank from the bright location and keep it just far enough away that the water remains clear. You may be sure that in a bright light, any tank will turn green. Anacharis planted in a tank tends to prevent multiplication of some forms of algae. Daphnia relish and increase rapidly on several of the motile species. Given plenty of air and introducing more daphnia than your fishes can eat will clear tanks rapidly, if the algae happen to be the right kind. It is the algae in their digestive tracts which sometimes makes daphnia appear so green.

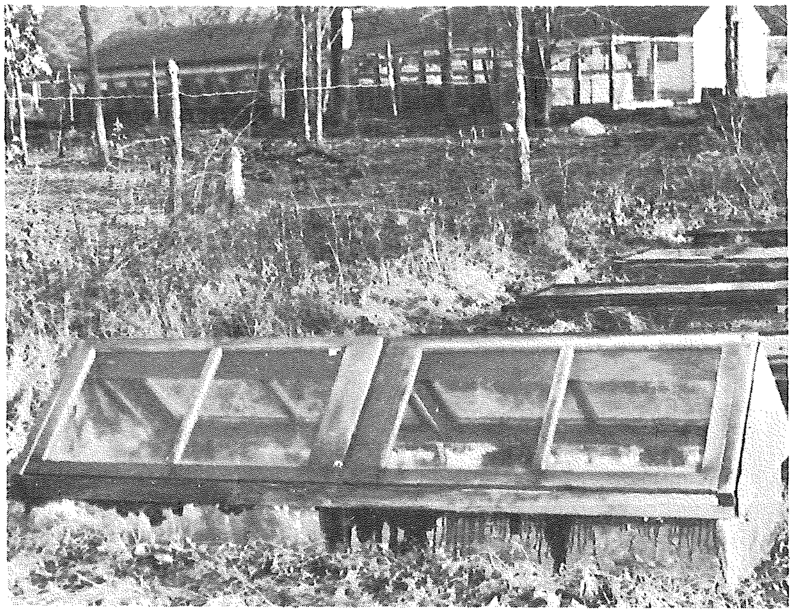
But any of the forms can be repressed by the amount of light to which the tank is exposed. Algae control is as simple as that. Some aquarists use snails or *Plecostomus* catfishes to eat it off the glass. There are advantages to leaving the green algae on sides and back of a tank but keeping it scraped off of the front with a razor-blade.

Another way to repress algal growth is by the use of shields to screen out the light. Aquarium decorative lacquer



Above is an efficient filter for a 5 to 10 gallon tank, below a heavy duty filter which can clean and purify a 20 gallon tank in a few hours.

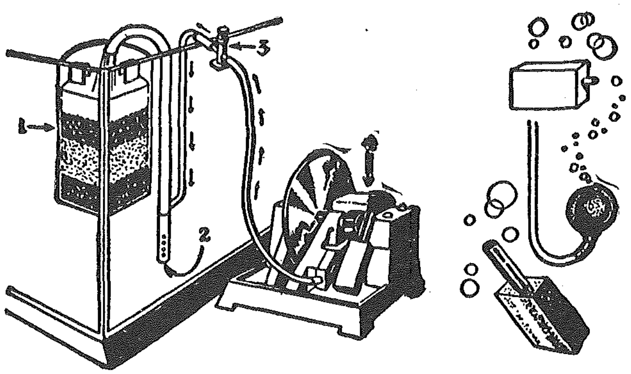
on the back and sides keeps out much light and furnishes a pleasing background. Floating plants also hold back the light to a large extent. These may be riccia, salvinia or water fern but not duckweed—a nuisance in any aquarium.



Outdoor tanks sunk in the soil and covered with glass, either flat or in the form of a small greenhouse, are excellent adjuncts for keeping guppies in the hot summer months or for use in growing live food.

***Filters.*** A filter helps keep the water crystal-clear. A filter can be elaborate and attached to the outside, or be a simple device which fits into the tank's corner and contains glass-wool and bone charcoal. Too many guppiests forget to wash the contents of the latter often enough and without realizing it, perpetuate contamination.

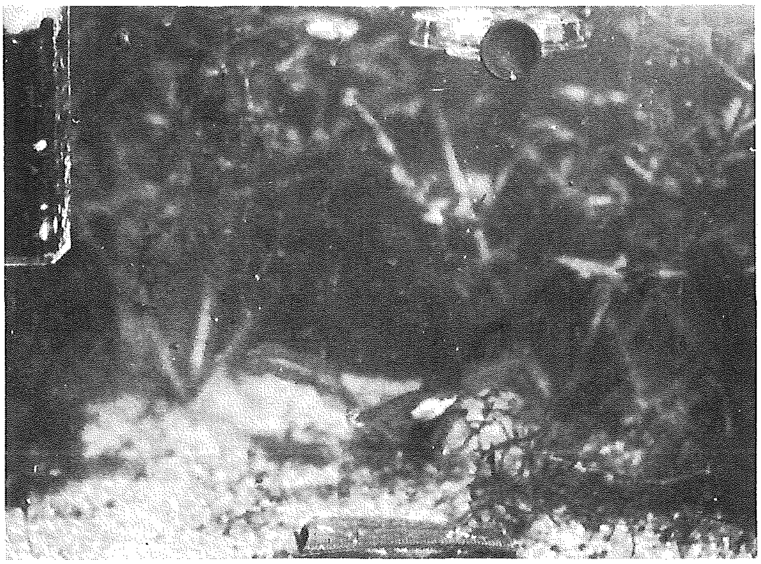
***Pumps.*** A filter cannot operate without a pump and as aeration is needed because the population has increased, so a pump, one as silent as possible, is required. One must think ahead in buying equipment. How much more will he expand his hobby? The pump should take care of his maximum requirements because one cannot realize much from turned-in, second-hand equipment. It pays well to buy a good pump because a heavy-duty costs but a little more than a weak pump.



(1) Inside filter, (2) intake stem, (3) valve, (4) an efficient air pump and three types of air stones.

If one is trying to keep expenses down and is willing to forego a filter, a fairly satisfactory aerator for one tank can be made from two 5-gallon cans. One sits on a table, the other on the floor. A one-eighth inch hose runs from a spiggot close to the bottom of one to a spiggot in the same position on the other. On top of each can a valve is soldered. An air hose connection runs from the valve on the can on the floor to the aerator. The can on the table is full of water; the can on the floor is empty. As the water runs down through the tube to the can on the floor, the air is forced out of it through the tube leading to the aerator. When all the water has run down, the air tube is changed to the other can and their positions reversed. It is surprising how long this simple device will keep air running into an aquarium.

Another device is a large auto tire inner tube which is carried to a nearby garage and inflated, then attached to the air tube.



Three helps to tank cleanliness are shown here; a filter, upper left; a food holder, upper center; a Hahnel collector, bottom. This last device, made of stainless steel netting and about the same proportions of a match-box but twice as large collects much of the drifting filth which otherwise may sift into the gravel.

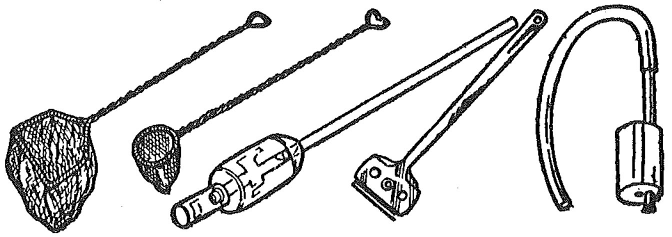
***Gravel*** is useful in holding plant roots. It is generally put into the tank deeper in back and sloping to none at all at the front glass. In a short time it tends to level out but while it slopes, the debris tends to move to the lowest point where it may be filtered out. Number two grade gravel is preferred by most fanciers. It pays to buy washed and screened gravel.

It is shipped in clean sugar bags and needs no preliminary washing before use.

The gravel should be kept meticulously clean—every cubic inch of it. Probably more poison generates from within the gravel than anywhere else in the tank. We like to use water sprite as a plant because it is such a wonderful sentinel. Its roots decay in any but clean gravel, and the plant rises to the surface. This warning means there is trouble brewing.

At least once a week the gravel should be stirred thoroughly except where the stirring dislodges plant roots. Any food which has settled amongst the pebbles will be swirled up into the water. The filter helps remove it and whatever settles in the front of the tank should be siphoned off.

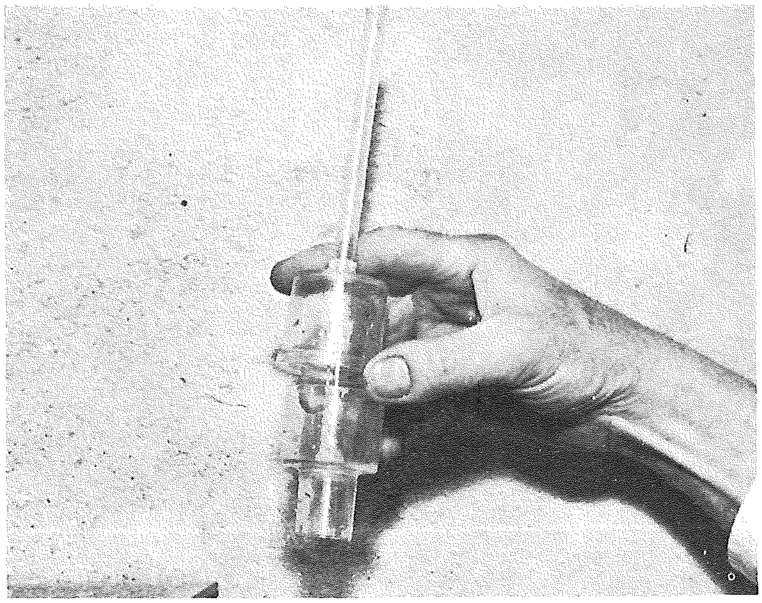
***Siphons.*** No set of aquarium gadgets is complete without siphons. A flexible rubber tube with a spiral wire spring at the bend is an excellent way to prevent kinking. A section of straight transparent plastic tubing is used to insert into the tank and siphon off those materials which are to be removed. To start a siphon, place one end in the tank, then suck on the other. If the water is unclean, fill the whole tube with water, and while holding the fingers over both ends or pinching the ends tightly, place one end in the tank and remove the fingers from the other. When the pressure is de-



Nets, dip tube, scraper, self-starting siphon.

creased, the water will run.

***Nets*** are necessary. They can be made by sewing a piece of woman's nylon stocking over a wire frame, or they can be bought. Nylon nets outlast cotton many times. Nets of several sizes are necessary. One small delicate net is useful in handling fry and in separating sexes early in life. A five-inch-wide net and an eight-inch are usually sufficient. In netting guppies to move them from one tank to another, it is best done at night. After the fishes have become quiescent, they can be caught easily with the aid of a flashlight, and when placed in their new environment, they show less fright than when moved in the light.



An excellent type of dip tube for collecting filth from the tank's bottoms.

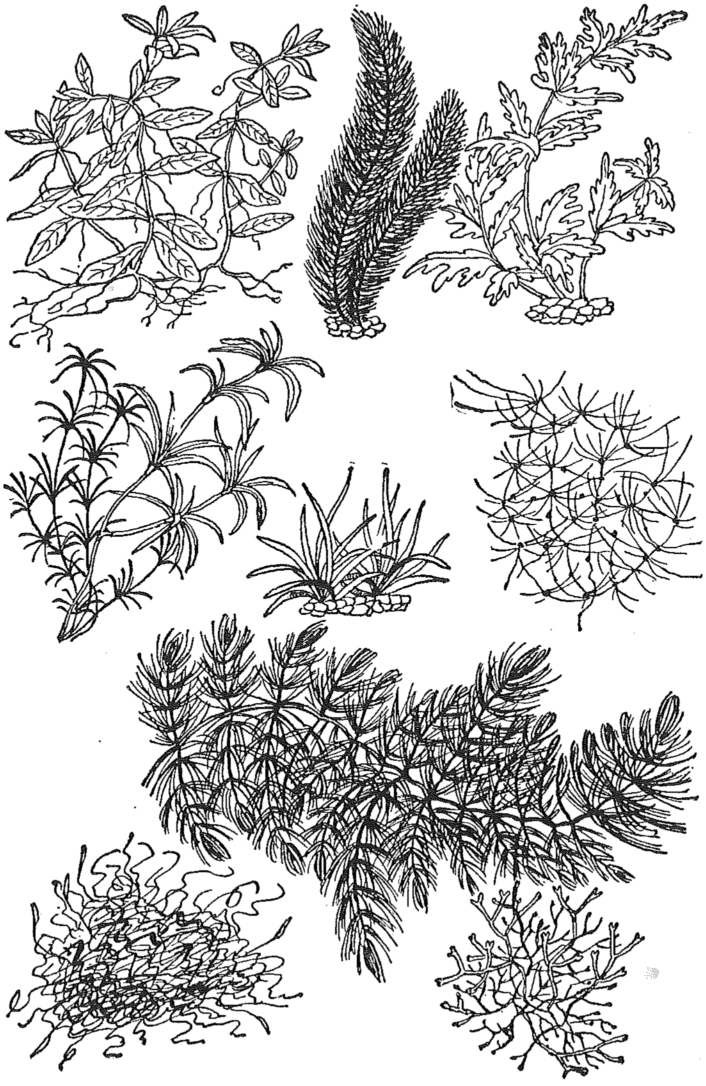
***Aeration.*** Oxygen is absorbed from the air by the surface of the water which maintains a fairly constant percentage regardless of fishes which use it or plants which produce it. And remember too, that when it is dark, plants are not using carbon dioxide ($CO_2$), nor giving out oxygen; more likely it is the other way round. The principle factor which controls oxygen percentage is the temperature of the water; cold water contains more oxygen than hot. The big problem in any tank is how to get rid of carbon dioxide. Plants will use a great deal of it, but carbon dioxide cannot escape from the water fast enough if the tank is overcrowded. Aeration, by this new concept, is not necessary to supply oxygen, but to help rid the water of $CO_2$. The huge number of bubbles increases the area of contact between air and water—a good stream of bubbles will remove the excess $CO_2$ rapidly. There are other poisonous substances—by-products of dead fishes or snails which aeration helps eliminate. But no amount will remove mineral salts or metallic poisons; the only toxins aeration removes are those which are gaseous.

A good test for condition and quality of water is to see if mosquito larvae will live in it. Another is to place a sprig of nitella in the tank. If that grows, it is quite certain that guppies will thrive.

As to water, our little fishes can live in various conditions of impure water when some other fishes die. One study revealed the fact that a colony of guppies flourished in an outdoor pool which was unbelievably foul. However, the carbon dioxide content was low, food was abundant. This, of course, is not a recommendation that you neglect your tanks—merely a salute to the adaptability of the guppy.

***Plants*** give rise to considerable controversy among guppy breeders as to which plants are best for this species. We can tell you what five of the most successful breeders contend and what they use. But first, let us understand that we are discussing utility—and not beauty primarily.

One man uses water sprite. His tanks for breeders have



two large plants each. As these develop small plants on their leaves, he removes them and plants them thickly in the gravel in ten-gallon tanks. Females have their young among the water sprite and the fry are able to keep away from the old fishes, which are heavily fed and removed at once when a litter is produced. No floating plants are used.

Water sprite grows differently under different lights. The ordinary incandescent bulb produces an almost fern-like growth. The total increase is rapid but the leaves have large numbers of serations and the general appearance of a fern. Fluorescent bulbs of the "cool white" class produce water sprite with an almost celery appearance. When the lights are close the plant produces even wider flatish leaves.

Another uses only the dwarf saggitaria which he plants closely enough so that with the new shoots it sends out, the aquarium bottom resembles an untrimmed lawn. The babies stay hidden in it. No floating plants are used.

A third uses najas exclusively for the protection of his fry. The mothers, he holds, eat fewer young when they give birth in a jar of najas than under any other conditions. For his breeders, he uses a variety of plants, mostly for their beauty.

A fourth uses nitella entirely to protect newborn young and in the breeders' tanks, cryptocorynes of several species because they are excellent consumers of carbon dioxide and do not require much light.

A fifth uses hornwort and najas with equally good results. There are several kinds of hornwort. The California variety has the leaves much closer than the Florida, but either makes good protection for fry, if there is enough in the jar or tank to carry right down to the gravel. In his breeding tanks, no

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Satisfactory hiding plants. Top, left to right: hygrophila, fox tail, water sprite. Center: najas, Amazon chain swordplant, nitella. Bottom: Spanish moss, hornwort, riccia.

floating plants are used but a number of species, principally corkscrew vallisinaria, water sprite, hygrophila, cryptocorynes, and in large tanks, an Amazon swordplant.

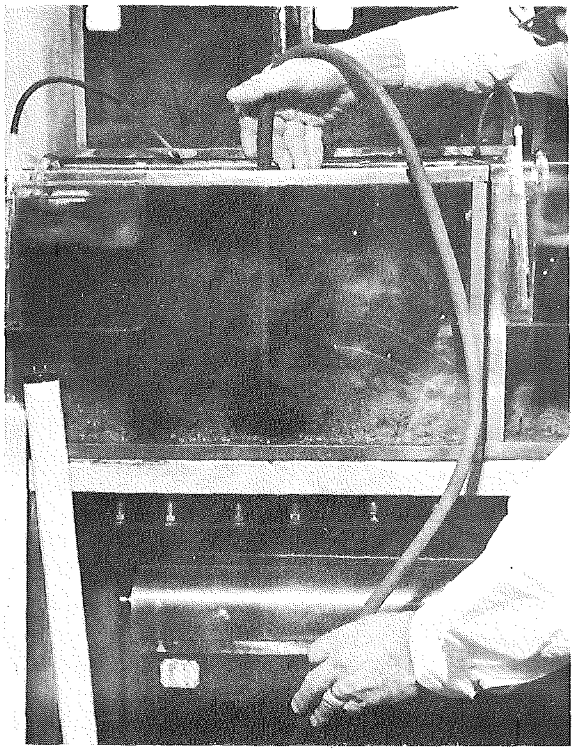
In open tanks where fishes may be raised the year round, you will see guppies multiplying rapidly among a variety of water grasses. In fact, these tanks will be so full of plants that you wonder where the fishes are. The plants and fishes are both primary products of these hatcheries. We have seen anacharis, corkscrew vallisinaria and other plants serving as fry protectors.

Almost all of the older books on tropical fish culture have a great deal to say about balancing the tank. By this they mean that as the plants grow and give up oxygen, the fish use it and in turn give off carbon dioxide which the plants use and convert into plant substance. Plants therefore were rated as oxygenators and we were advised to plant those which gave off the most oxygen. In light of recent research, this concept has changed.

***Dried Protective Grass.*** Spanish moss, dried and thoroughly washed, makes another excellent protection for fry. All dealers in fish supplies handle it. Fry can easily escape mature fishes in its mass, but the stuff is dead and fails to help in water purification as living plants do.

***Plants as Ornaments.*** For the ornamental tank in one's living room, for example, beauty is more important than utility. Not that the aforementioned plants lack it; it depends on how the plants are arranged. Hornwort may be planted and a sprig gracefully growing from a corner adds a definite touch of beauty. But most floating plants are a detriment, obscuring the rooted plants and shutting off the light from the reflector above, hiding the beauty of the fishes. The list of possibilities of decorative and useful plants is so large, you are advised to consult your nearest dealer or a book in which the many plants are described. Several of the beautiful catalogues of fish supply houses give adequate descriptions.

Having decided on the plants and having bought them, you can enjoy arranging and rearranging them until you have your tank to suit your taste. Unfortunately it will not remain that way. Plants grow and some will have to be trimmed constantly and replanted. This is one argument for using only slower growers like vallisnaria, cryptocorynes. Plant a tank with hygrophila or the floating plants and you



An easy way to remove the debris from a tank is by the use of a rubber tube with a plastic tube on the end one inserts into the tank. The water runs into a bucket on the floor.

will have considerable trimming to do. But we must admit that the very speed of their growth indicates what excellent purifiers they are.

***Plants as a Source of Income.*** No one with a large number of tanks can help but have some income on the side if he will harvest his plants and carry them to fish supply stores. Some enterprising fish hobbyists make a practice of transplanting some of the faster growing plants to outdoor tanks and harvesting nice crops. Certain plants do better in some environments than others, and one soon learns which he can grow best. It scarcely pays to bother with the cheaper plants like cabomba, anacharis and those harvested by professionals from lakes, but nitella, cryptocorynes, Amazon swordplants, hygrophila are nearly always in demand at good prices.

### TEMPERATURE

Guppies have been known to stand the low extreme of 50° temperature and a high of 97°, and live, but not for long. The ideal breeding temperature is 75°–85°. At 70° they may be said to exist, for certainly in indoor and outdoor tanks which remain at that figure there is little breeding activity and not too rapid growth. Any degree below 70 is detrimental. Any above 90 is also detrimental. They can stand fairly sudden temperature changes better than some fishes. It is conceivable that a wild guppy moving about in its natural environment would swim from warm water to an entrance of a spring into the brook where it lives and find a 15° drop in temperature and yet live. In practical working with the fishes, no harm seems to come in transferring from one tank to another with a 10° difference between them, especially when one is warmer than the other. We have carried guppies home in winter when the temperature outside was so cold that the insulation around the container failed to keep the fishes warm. The water had practically numbed them. On pouring them into 75° water, they quickly revived without harmful effects.

### SNAILS

Whether we want them or not, a few snails seem to become inhabitants of guppy tanks sooner or later. After a time they become pests. Some of the larger and more interesting snails help keep the tank populated with infusoria and studies where several were used in tanks with fry indicated that the fry grew faster when snails were present.

Snails eat much unconsumed food and algae but it takes many of them to eat the amount which covers some glass. And they have decided disadvantages. When they die and decompose in their shells, that waste must diffuse throughout the tank. When one of the larger species dies, the effect often kills all the fishes. Nor has it been established that snails are not the intermediate hosts of at least one parasite which kills guppies. The number of white shells seen in so many tanks is evidence that snails are not always beneficial.

If you want snails, visit any aquarium supply store and choose the kind you want. They cost but little and you will soon be giving them away or employing a Cumberland turtle to eat the small ones for you as a means of holding the snail population in check.

A scientific study of populating a tank with young guppies and then studying it for many years without removing any but dead fishes produced some interesting results. The tank became thickly populated up to 6–8 months when cannibalism and natural death caused a decrease in the total numbers but the total weight increased as the biggest fishes grew older. After one and a half years, both numbers and weight declined but there were still enough old fishes left to eat the babies.

After three years the number of predatory adults was so greatly reduced that the numbers again increased. An interesting fact was the changes in the survival by sex. In the early stages of the population cycle, there were about equal numbers of both sexes. In the declining period few males survived and in some cases only females survived. July and August were the hardest months on the fishes; more died then than at any other time.

## CHAPTER IV

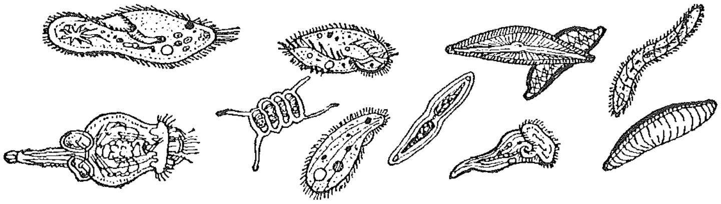
# *Food for Guppies*

### NATURAL FOOD

WE THINK OF LIVE FOOD AS THE NATURAL FOOD of guppies, but what we furnish in the way of live food is apt to be quite unlike the natural food in the natural habitat of the fish. Fortunately the guppy is so catholic in his food choice and so many live foods have been found to agree with his digestion, that we can supply a variety of foods and our fishes will thrive; we need not investigate the exact feeding habits in the wild state. The following live foods are useful and easily procurable:

***Infusoria.*** Water, which to us appears crystal-clear, when observed through a microscope is seen to have many tiny living organisms. Water from a ditch in summer teems with them. A great variety of forms will be seen and even though it requires a microscope for us to see them, the tiny guppy apparently sees them, eats and thrives on them.

It is for this reason that infusoria (tiny animals, plants or forms having characteristics of both) is ideal as a food for small fry. In summer, unless there is a drought, green ditch water is found everywhere filled with infusoria; in winter they may be cultivated. They thrive on decaying vegetable matter. Some alfalfa hay with its fairly high protein content, decaying lettuce, and plenty of sun or artificial light makes a culture quickly. As portions of this green water are poured into a tank, the opaque material is seen to diffuse into the clear tank water and the fry appear to attack it. Obviously what we cannot see in detail is either visible to the fry or they find it "with their noses".

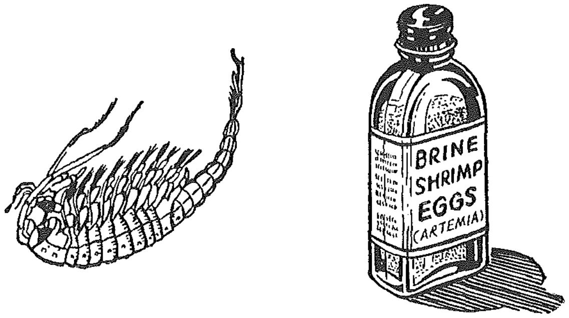


Various kinds of infusoria (highly magnified).

Some few persons make nets of thin muslin and go infusoria collecting. As infusoria collect like a scum on the cloth's surface after netting them, it is better to lift the net up and let the water drain out before repeating. If you try it, turn the net inside out frequently and swish it about in the water of the collecting pail.

Consecutive cultures are maintained by larger guppy breeders who use one lot to infect the next. You may find tubs in a back yard in the summer breeding infusoria for their owners, or in winter, flat pans on window sills in a southern exposure where sunlight strikes them most of the day. Probably no better starting food is known for guppy fry. If allowed to stand too long the odor may become objectionable but the culture is useful long before such a stage is reached.

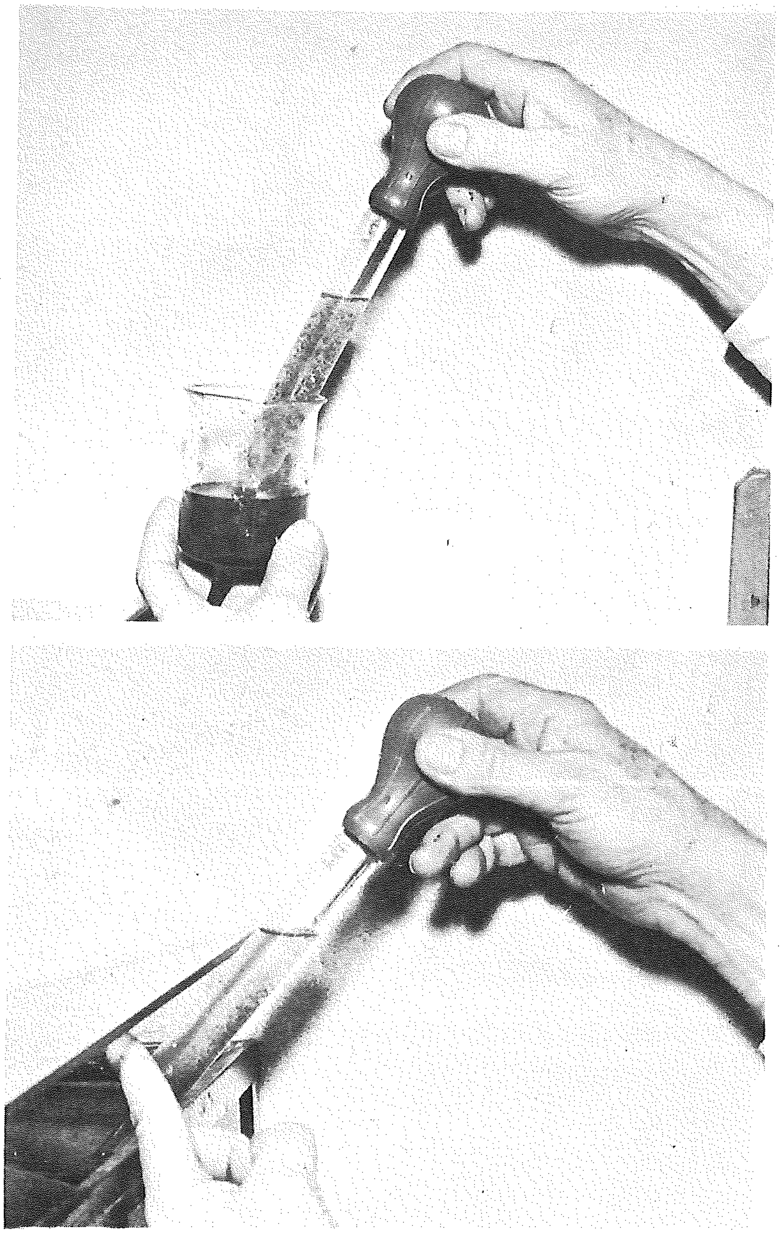
***Brine Shrimp.*** Guppies of any age relish brine shrimp. The brown roundish tiny eggs may be had in any fish supply store and if placed on briny water, hatch and cloud the water pink. Those of us living near the ocean can use natural sea water; those without access to it can use salts made by evaporation of sea water or a formula of salts approximating those in sea water. This salt may be purchased from one of the wholesale aquarium supply houses. My own experience indicates that better results can be obtained by adding some salts to the sea water as the little shrimp thrive in exceedingly salty water.



Brine shrimp (X 4) and bottle of eggs.

Many who have used brine shrimp seem to think that they must be removed immediately upon hatching but such is not the case. If some air is allowed to bubble through the tank and some green sea water is added, the brine shrimp will grow. In one 200-gallon outdoor tank of mine, filled with sea water, myriads of little creatures grew to full size. In this tank they lived all summer.

To harvest the little shrimp from an aquarium, place a light at one end and the cloud of them will gravitate to it where they may be siphoned into a muslin cloth strainer; in this manner only a small part of the salt water is disturbed —what runs through can be then put back into the tank again and more brine shrimp eggs added to it.



One way to feed live or frozen foods (daphnia, brine shrimp, or naupleii, red worms.) Allow the frozen foods to melt in a beaker of water, then draw some into a syringe and gently squirt it into tank after tank.

The muslin cloth can be dunked in a small amount of fresh water and the shrimp fed to the fry either by pouring or using a medicine dropper.

The newest fish food is frozen newly hatched brine shrimp (naupleii). They come in small polyethylene bags and are relatively inexpensive. Nothing we have tried grows fry so rapidly.

Research conducted by the Sanders Brine Shrimp Company of 800 Washington Boulevard, Ogden, Utah, the world's largest suppliers of artenna eggs and frozen adult brine shrimp, shows that, because of the unique method of hatching, the eggs are most efficiently hatched in a jar with a flow of air which keeps the eggs in movement and prevents their settling. Temperature is most important, the maximum hatch occurring in twenty-four hours at eighty-five degrees, and the salt concentration was five tablespoonfuls to a gallon of water.

Frozen adult brine shrimp make an excellent food and even month old guppies eat them lustily. They contain fourteen percent dry matter, three times as much as daphnia, tubefex or bloodworms, and should be worth three times as much, ounce for ounce.

***Microworms.*** The next larger live food useful in feeding the guppy fry is the microworm. It is just large enough to be visible. These small worms were introduced to the world from Sweden. The females are about 1/12 of an inch long; males a little smaller. The female bears about fifteen live young at one time which mature in a few days. They grow in many media; a mixture of bread and yeast kept almost liquid and inoculated will soon be teeming with these whitish creatures. It is well to maintain them in covered jelly glasses with smooth sides because they crawl up the side of the glass when the population in the medium becomes too dense, and may be scraped off with a knife blade and fed by dipping it into the water of the aquarium. Fry have to be trained to eat them, but once they learn the taste, they grow well on microworms.

***Daphnia.*** It may amaze some guppy breeders to read that many of the top experts do not regard the daphnia the best guppy food. Others feed almost nothing else. Daphnia can be purchased at fish supply stores but are quite expensive, and since they do not live long, must be fed quickly to the fishes. The daphnia exhaust the oxygen from their containers and need to be kept cold and thus inactive if they are to live as long as possible without food. Some stores sell frozen daphnia, and these, if fed soon after thawing, seem to serve almost as well as fresh. A good place to find daphnia is in fresh water duck-pens. Duck excreta seems to have a particularly beneficial effect on daphnia growth. Daphnia are curious, tiny arthropods ranging in color from red to green, depending upon their food. There are about fifty different species. One, *Daphnia magna,* is many times larger than the smallest species. The commonest is *Daphnia pulex.* Look at one through a binocular microscope and observe what an interesting creature it is—no notch where its neck should be, a long spine for a tail. In fact, it would seem that a guppy would have his digestive tract scratched by the daphnia's spine. *Daphnia longispina* has a spine almost as long as its body.

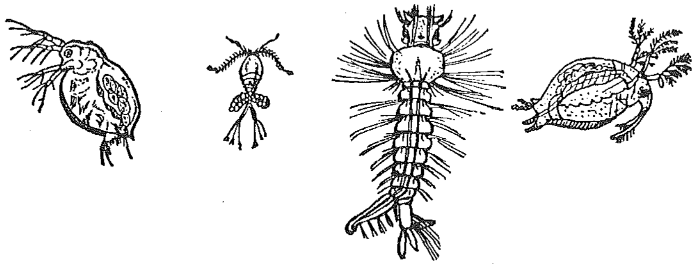
Daphnia may be cultivated in abundance in the home of northerners during winter months and in outdoor tanks during spring, summer and fall, or in an outside tank the year round in the south, and in the warmer months of the year in the north. But in many places such as swamps, pools, ponds, drainage from barnyards or city dumps, they often can be found in such abundance that there is no need to raise or buy them.

For collecting, one needs a daphnia net. This should be constructed to look like a pillow case made of cheese cloth or fine nylon. The net is attached to a long pole by a net ring on the end. The daphnia are located and the net is moved through the water in a figure 8 motion. Sometimes as much as a pint has been found in a single net, but more often only a few teaspoon or tablespoonfuls are found. The container needs to be iced or, on a hot day, most of the little creatures will be dead before you arrive home. Anyone or any group can, with good fortune, find enough to feed some to their fishes and freeze the rest which may be stored many months.

Those with many tanks should have a set of daphnia screens, each a little finer than the upper. The daphnia are placed in the coarser, and washed. The small run through the meshes of the sieve and are caught in the second screen, while the smallest are captured by the mesh of the finest. The three sizes of daphnia may be fed to the appropriate size guppies.

One warning: Do not put a heavy feeding of daphnia into a tank of guppy fry. The daphnia not only tend to exhaust the oxygen from the water but they also eat the infusoria on which the fry feed and slowly starve the guppies.

***Mosquito Larvae.*** Mosquitoes throughout the spring, summer, and fall lay eggs on the surface of any water they can find, especially water which has some decomposing organic matter in it. The eggs are deposited in tiny rafts and hatch into small wigglers which develop in a few days into sizeable dark-brown larvae—a prime delicacy for mature gup-



Live food for guppies. Left to right: daphnia, cyclops, mosquito larva, bosmina.

pies. For small fry, it is advantageous to collect the rafts which can be found floating on stagnant water. If these little rafts, which contain larvae, are left floating in the fry tank, the fish will consume the tiny larvae as soon as the latter hatch and swim downward in the tank.

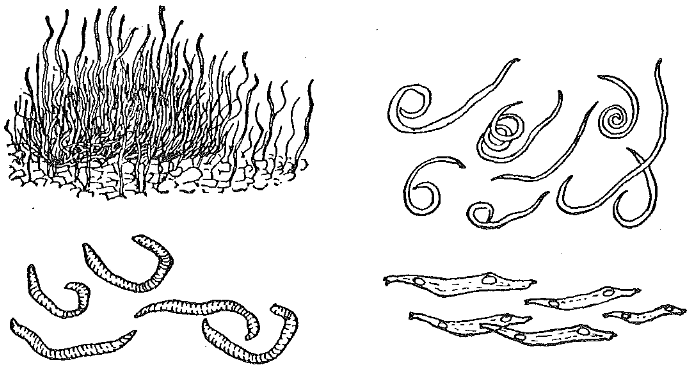
Wigglers come to the water's surface and stay there breathing through a tube pushed up into the air. The slightest jar or disturbance will send them scuttling downward. To collect the larvae it is necessary to plunge a net in and swish them up in it before they have dropped too low to scoop up. Mosquito larvae stand crowding in a container because they are not dependent on the oxygen in the water. On the other hand it never pays to catch more than one's guppies can eat in a day or two because if they are not promptly fed to them, the larvae will turn into mosquitoes and you will have a room filled with flying insects.

***Tubificid Worms.*** These worms, for sale in most all fish supply stores, are common residents of fresh or brackish water. They live in tubes in mud in either still or running water, sometimes in such quantities as to form reddish patches on the mud where they wave their hinder-ends in the water. The usual species used by guppiests is *Tubifex tubifex,* a worm of about sixty segments and one and a third inches long. However, of the *Tubificidae* there are 113 known species, several of which can be useful for guppy food. *Tubifex tubifex* can sometimes be found in huge numbers in shallow water below a sewer.

A good many so-called tubifex worms are actually not of the *tubifex* genus, but are *limnodrilus* of which about twenty-eight species are known. Very little preference is shown by guppies for one or the other. Both are members of the *Tubificidea* family for which reason it has been suggested we discuss them under the appellation of tubifacids, not tubifex.

Wherever they are discovered, the easiest method of harvesting them is to shovel the top two inches of mud into a water-tight container and after the worms have been rinsed out of their tubes, they will tend to cling together in groups and settle at the bottom of the container. The mud is washed out and the worms removed, stored in a cool place or in gently running water.

Another way of separating tubifex from the mud is to place the mixture in a muslin cloth, suspending it so just the lowest part touches some clear water in a pail placed below it. The worms wiggle through leaving most of the mud behind. Placed in a refrigerator in shallow pans they will last several weeks. If tubifex worms become overheated or if some in the group die, the whole group dies quickly, producing an evil odor. To store small numbers of tubifex for as long a time as possible, place the worms in a shallow jar with an inch of gravel in the bottom. The worms, instead of balling up, will crawl into individual sites in the gravel, and, if the water is circulated or changed frequently and the jar kept in a reasonably cool place, serve as many meals for the guppies.



Tubificid worms, white worms, blood worms, glass worms.

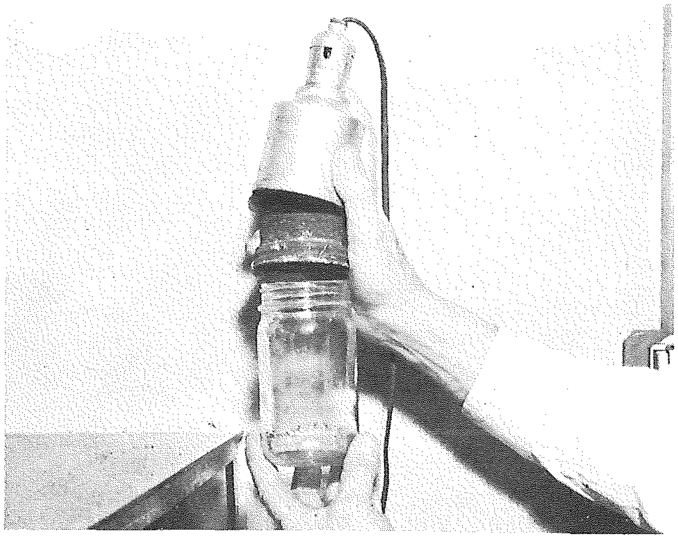
Transporting tubifex worms is chiefly a problem of preventing asphyxiation. Where they are massed together some cannot obtain oxygen nor dispose of wastes, so they die. I have had best results in carrying them home by using, in place of water in their container, several ice cubes placed on the mass of worms, then storing them in shallow pans. The live ones draw away from those which die and remain in tight clumps so the water may be changed daily. Tubifex worms can live without food for weeks under ideal conditions.

***White Worms.*** Many small worms are white but what has come to be called white worms by fish enthusiasts belong to the genus *Enchytraeus,* of which there are about 40 species. *E. albidus* is one of the best. In Europe and America, this is a common worm. It is found in the U.S. from Maine to New Jersey along the seashore near the high-water mark. Sometimes a nice lot can be located in decaying seaweed or under stones. It is thin and nearly an inch long. It breeds best at fairly low temperatures for which reason it often is raised in refrigerators at 45°–50° F. It lives on decaying organic matter and fresh food. Bread, cracker crumbs, dried milk make excellent food. Some prefer milk and oatmeal gruel. Some persons think white worms will live only in peat or black soil. They will thrive in ordinary rich garden soil. Spray it to moisten but it cannot be too muddy if they are to thrive. The container should be covered because if the worms become crowded, they will crawl out of their container and migrate about.

A smaller, recently introduced species that breeds in drier soil may replace the *albidus* species.

Separating the worms from the soil is not difficult with the proper equipment. Three-pieced worm separators may be purchased, which accomplish the feat neatly. A portion of heavily populated earth is placed in a container (middle section) with a wire screen bottom. This shallow container is put on top of a container of cool water. A light above the earth in the top section furnishes heat which warms the earth so much that the worms leave it, burrowing downward and dropping into the water where they collect at the bottom. The gadget is taken apart, the water poured off and the worms recovered and fed to the fishes.

A worm separator is excellent but there is one way to gather them without it. If you plan to feed white worms to your fishes two or three times a week, feed the worms a porridge, not over a tablespoonful, the night before, placing it in one or two depressions in the soil's surface. The worms will be packed about it and you can gather a large number. What if a little porridge comes with them? It is perfectly good food for the guppies.



This white worm separator is efficient and cleans as it separates. The jar is filled level full with water; soil containing worms is placed in the middle compartment which has a screen bottom; the hood contains an electric lamp, the heat from which drives the worms to seek the cool of the water.

Another way of serving them to guppies is to place some soil containing a large number of worms in a sauce dish. Let the dish down into the tank by a string tied about it so it will not tip or allow the dirt to escape. As they leave the soil, the worms will be picked up by the fishes.

Many fanciers have tried placing a piece of burlap over the soil, feeding on the top of the burlap, then covering the cloth with a piece of cardboard. The worms crawl through the burlap and feed, remain and cling to the cardboard from which they can be fed to the guppies.

***Bloodworms.*** The larvae of a mosquitolike insect, the midge, are sometimes blood red in color and jointed, living in silty or muddy places though sometimes caught in daphnia nets from fairly clear water. Bloodworms will live a long time in cold water but let the water warm up and the worms will soon develop into winged insects.

***Earthworms.*** Guppies will eat shredded earthworms but few persons seem willing to shred them. An English patent covers an ingenious shredder made by circular scorings on two rectangular-shaped pieces of flat stainless steel. A worm is placed between them and the pieces are rubbed together until the worm is formless and in sufficiently small shreds to be eaten by the fishes.

Everyone has seen earthworm casts on lawns. The worms eat huge amounts of organic matter mixed with soil, digest and absorb but a small proportion of what they ingest. Therefore, earthworms, shredded, tend to muddy the water unless they are kept unfed for a day or two, or long enough for them to disgorge, or they may be shredded and placed in a fine net and rinsed.

To quickly gather a cup of earthworms without having to dig for them, put enough potassium permanganate crystals into a pail of water to make it a deep pink. Pour this solution on a patch of grass and the worms will start coming out of the ground in a few minutes.

Earthworms may be stored in tanks in the cellar where they will live for months. One species, soilution worms, are bred by fanciers who screen out and feed the tiny worms and reject the larger. It pays to feed the stored worms. Meal-type dog food or even stale bread is acceptable to them.

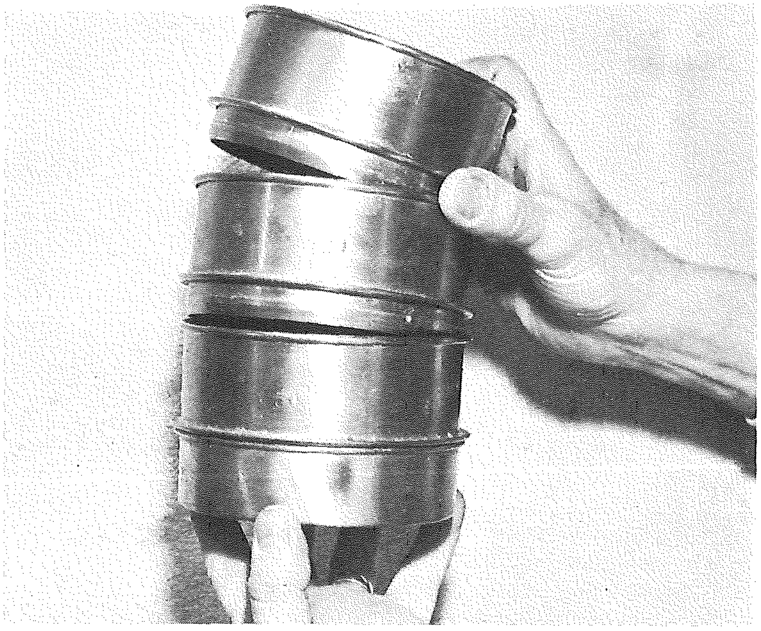
***Glassworms*** (*Chaoborus*). When netting for daphnia in a woodland water-hole, especially in shady places, it is not unusual to bring up hundreds of long, almost transparent creatures, pointed at the ends and half an inch long, with darkened areas near each end. They lie level with the surface of the water. These are the larvae of aquatic insects. Visible parts are actually the eyes and small bean-shaped air-filled balancing organs which are located in pairs at each end of the segmented body. One midge lays a mass of about a hundred eggs on the surface of the water, and the little glassworms hatch from them. Before the glassworm becomes adult, it pupates once and changes into a comma-shaped organism with a large head and two air tubes which it pushes up through the water into the air. At both stages, guppies enjoy it as a food. They are frequently netted under the ice in winter and sold in fish supply stores. They stand crowding remarkably well but not heat.

***Other Live Foods.*** There are dozens of other living creatures on which guppies thrive. Doubtless some of these forms will become better known, collected and sold to guppy breeders or the enthusiasts will learn how to breed them. For example, edible Cyclops, one-eyed crustraceans, are especially relished. They are prodigious breeders. One Cyclops could leave 4,500,000,000 descendants in a year if none was destroyed. Perhaps you will learn some of the secrets of raising this and other species and will help other aquarists with your knowledge. "The sky's the limit."

## PRESERVED FOODS

Under this heading we shall consider the dried, canned or frozen foods, none of which is alive.

***Prepared Foods.*** All fish supply stores sell a variety of dry foods. Some is only finely ground dog biscuits—a diet quite inadequate for guppies. As yet, no laws compel the manufacturer to tell us on the package the contents of these mixtures. Some are a variety of many of the individual ingredients advertised in any catalogue or sold in any store. Following are such ingredients which may be bought and mixed but it is safe to say that most of the commercial mixtures are made to appeal to the imagination of the buyer rather than to his fishes. And with a few exceptions, no research has been done on the foods, the manufacturers depending on sales records as a test of their value rather than upon scientific studies. Those manufacturers who have done methodical work and based their final formulas on the



A nest of screens ideal for sifting dry food or screening daphnia into several sizes. The sizes are 20, 30 and 50. Any dry food which passes into the pan at the bottom is dust and can be discarded.

results of years of experimentation have furnished us with some surprisingly good fish food.

Some of the appeals offered by food manufacturers are quite ridiculous and, to those who have conducted research, humorous. The value of adding chlorophyll to food of fishes which eat algae, the value of adding such vitamins as $B_{12}$ which fish get every time they eat a fry or almost any animal protein foods, the value of large amounts of antibiotic waste for growth, remain to be demonstrated.

Warning: It is best, in buying fish food, to put little stock in testimonials. If you read that Blank fed "Make-'em-Breed" fish food, you may well believe it is true. BUT ask, how much did he feed? How long? and most important, was it the *exclusive* food? Some fishes live in spite of the inferior food fed to them. One such testimonial which we investigated, revealed that the prepared food was fed in small amounts once a week; live food being fed at all other meals.

One disadvantage of dry food is that it brings about the need of frequent siphoning. Even the best foods are not completely eaten but drift to the low spots in the tank along with the feces of the fish, and create an unsightly fluff of brownish sediment which cannot be left long if the fishes are to thrive. On the other hand, frequent siphoning means that more fresh water is being put into the tanks to the advantage of the inhabitants.

### DESIRABLE AVAILABLE DRIED FOODS

Shrimp meal
Crab meal
Whitefish meal
Fish meal
Whalemeat
Beef meal
Liver meal
Ant eggs
Fish egg meal
Fish liver meal
Bread meal
Wheat germ meal
Dried flies

These are not to be fed alone, but in mixture. Bread is excellent if adequate amounts are fed. If too much, it quickly deteriorates. But so do other foods. Dehydrated whale meat is probably the best dried food available. It is almost all protein of excellent quality—eighty-six percent, and is readily eaten. You can tell by the protein guarantee how much bone or indigestible material the foods of animal origin carry. Some white fish meal made without bones may run eighty percent protein, whereas with bones, it will be sixty-five percent. And very little of the bone is eaten.

### UNDESIRABLE AVAILABLE DRIED FOODS

***Powdered Milk.*** Causes murky water as some of it dissolves before it can be eaten.

***Bone Meal.*** Settles too fast and fishes do not need it when other foods like fish meal are fed.

### CANNED FOODS

***All Kinds of Fish.*** This may be shredded, or tied on a thread and suspended in the water. Guppies' jaws are strong enough to etch a shrimp right out of existence and softer fish goes even quicker.

***Fish Eggs of Several Varieties.*** Only the smallest are useful for guppies and the salted types are not relished.

The several varieties of foods in jars or tubes are really canned foods. If they are quickly eaten by the fishes these preparations are admirable. If too much is fed the foods may disintegrate and foul the water. One enterprising manufacturer suggests that the lids from his fish food jars be used as dishes in the aquariums. A lid sits on the gravel and a small lump of the food is guided into it, the fishes eating from this dish.

### FROZEN FOODS

The following table shows the percentage of water in some live and other foods. White worms stand at the top of the live foods and probably show a higher percentage than their real food value because within their digestive tract there is so much undigested food with a low water content.

| *Food* | *% Water* | *% Dry Matter* |
|---|---|---|
| Dried Foods<br>(Average of all) | 7 | 93 |
| Canned Food | 74 | 26 |
| Glass Packed Food | 52 | 48 |
| Daphnia | 94.85 | 5.15 |
| Tubefex Worms | 95.56 | 4.44 |
| Blood Worms | 91.52 | 8.48 |
| Brine Shrimp | 86.79 | 14.21 |
| White Worms | 76.62 | 23.38 |

These figures show why so much more live food must be fed than of dry food. For instance, if a *teaspoonful* of dry food is sufficient for all of your fishes for one feeding, then you would have to feed four *tablespoonfuls* of daphnia or tubefex worms to supply the same amount of nutrition.

The figures also explain why too much dry food is usually fed by persons unfamiliar with the facts. If a person is used to feeding a small ball of tubefex twice a day to one tank of fishes, he generally feeds almost as much dry food. His tank clouds, food lies decomposing on the bottom and the fishes die of poisoning.

One reason why the guppy can devour such prodigious numbers of mosquito larvae is because of the low water content of these wigglers. The mouths of many fishes are equipped with crushing jaws, which mash the food and squeeze the juice from it. They live on these juices. Some fishes, notably sharks, mash their food and regurgitate the residue. Guppies may well be feeders of this kind, not that they regurgitate but they reduce the size of live food very rapidly in order to be able to consume so much. And as we have seen, when a guppy must live on live foods which contain only 5% of dry material, he must eat great quantities (in terms of volume) in order to live.

***Daphnia.*** They have already been considered under the daphnia section of Live Foods.

***Brine Shrimp.*** We have already considered this excellent food. One precaution about feeding may help you keep your tanks cleaner. If you find there is a cloud of reddish fluid along with the frozen shrimp, then hold the shrimp in a net until they are thawed and rinse them so you have only clean food to drop into the tank. We have fed brine shrimp which have been frozen for eighteen months with excellent results.

***Blood Worms.*** These are the same creatures we discussed on page 60 but frozen into a solid block. In this condition they will keep almost indefinitely provided the temperature is kept below zero.

***Mosquito Larvae.*** There is no reason why surplus mosquito larvae may not be preserved by freezing. Guppies relish them as much when they are freshly thawed as they do fresh, and I sometimes think even more.

***Fish Eggs*** (Roe). Flounder roe or roes of any fish which lays small eggs can be bought and stored. It pays to cut the roe into chunks of the size which can be fed in one feeding, deep-freezing them and getting out a piece long enough in advance so that it will be thawed at feeding time. Too many eggs tend to make the guppies over-fat.

***Fish*** (*Fish* is the proper term. It is used here to mean food. The plural of a living fish is *fishes*). Some will be eaten raw and some will have to be cooked before guppies can eat it.

While it is true that frozen live foods are among the best, be sure that you buy only such foods which were frozen while they were alive and not after they were dead and decomposed. Among lots of daphnia which I have bought I have found complete disintegration of the creatures when the lump thaws out. A great deal of nasty reddish liquid clouds the water. It is risky to feed.

The same precaution applies to frozen foods which have been thawed in transportation or from the breakdown of machinery; most of it is worse than useless. One of the best frozen live foods, brine shrimp, when properly handled comes as clearly distinguishable individual shrimp. But let them thaw and refreeze and the individuals disintegrate and pollute the water. If you buy a quantity of any frozen live food for storage, take a sample and drop it into a container of clear water and watch as the individual animals separate. If they are not clear cut individuals the product is not good.

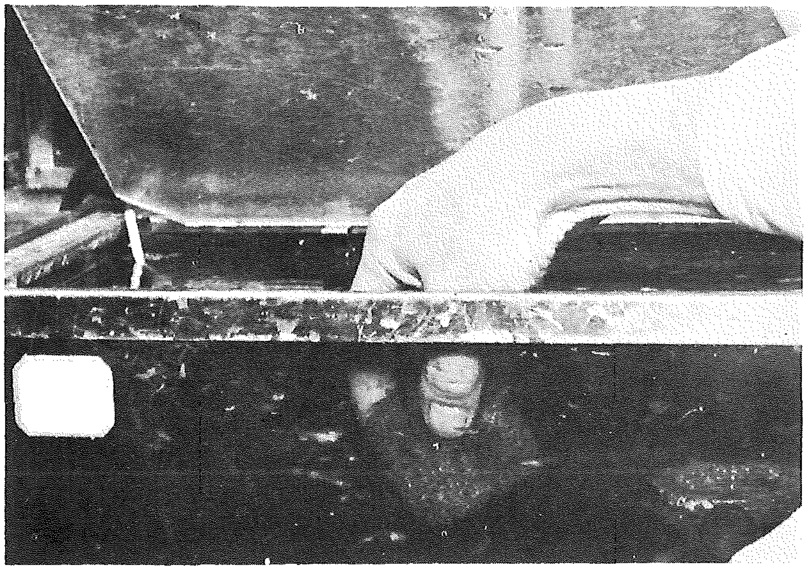
It is so easy to freeze one's own live food and to feed it that it is surprising more persons do not do it. A good way for a person with a large aquarium with many tanks is to fill one or two ounce paper cups with live food, and place the containers in the quick freeze compartment of a deep freeze. When they are frozen store them in the freezer at zero or below. At ordinary refrigerator temperatures they will not remain frozen and will keep but a short time. I like best to fill quart milk boxes with the live food. When I need some I saw them up into one inch long blocks.

### HOW TO FEED FROZEN FOODS

You can thaw the frozen food in water and feed by pouring the mixture into a tank, or you can use a large syringe, or best of all, simply dip the chunk of frozen food into the tank's warm water. A small amount will melt off and be left in the water. Dig it into tank after tank. If there are but a few fishes in a tank, you need dip only one corner of the cake, and if the tank's inhabitants need a great deal of food, hold the whole cake in the water and move it gently. If you do not use all of the cake, put the remainder into the freezer again. By this method we can feed one eighty gal. tanks of guppies in five minutes.

### HOME PREPARED FOODS

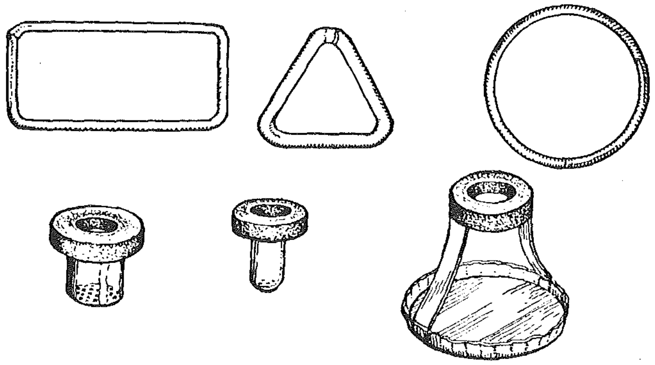
Home-made foods are easily prepared if it is desirable to make them by pulverizing the ingredients and thoroughly mixing them. If sufficient food is used, the purchase of an electric liquid blender is warranted. Most formulas involve the use of liver. Our favorite is made in the following way: beef liver, from which all the tough stringy substance has been removed, run through the blender to which an equal amount of water and one or two drops of percomorph oil have been added. Pour the mixture into a container and add as much cereal, baby or puppy food (Cerevin, Pablum, Pampa are preferred) as the liquefied liver will take up. Put in small jars, place in water almost to their rims and boil for a half an hour. This coagulates the liver proteins and glycogen and keeps its juice from separating from the cereal. The jars can be placed in a deep-freeze and removed a day



Feeding frozen daphnia or other food — dip the lump into the tank and swish it gently. A little thawed food will be washed off.

ahead or stored in small amounts in the refrigerator. There are many formulas in use, some of which are quite elaborate. You may find one that suits your purpose better than the one given above.

It is easy to gauge the capacity of the guppies in a tank by observing how quickly they eat the lump of food that you give to them. If they eat it and appear hungry for more, give it to them; if they leave some of the food, do not feed as large a quantity the next time.



Feeding devices: glass squares or ring, worm feeders, floating feeding device with tray.

**FEEDING DEVICES**

Under the general classification of useful, but not essential gadgets for the guppy tank are those ingenious devices which help keep tanks clean and neat.

***Feeding Rings.*** Rings or squares of floating glass tubing help to hold dry food in a restricted area. When dropped on the surface of the water, food disperses by surface tension over the whole area. The feeding ring, however, holds the food in one place. Some of it is certain to settle down and the ring also causes it to drop over a small area of the gravel.

***Rings with Trays.*** An improvement of the ring is a light tray below it, held to the ring by plastic strips. Much of the food uneaten on the surface falls into the tray and is eaten from it by the guppies.

***Worm Feeders.*** Floating devices into which worms are placed and from which they crawl, one or two at a time, help prevent tubefex worms from crawling into the gravel before they are eaten. White worms too are fed in them. Some fanciers use trays under the feeder to hold the worms if too many should come through the feeder.

***Drip Tube.*** A wonderful device for growing fry rapidly is a drip tube connected with an infusoria tank. It can be arranged so that as the green water drips into the tank, an equal amount of water runs out. (The air tube can be used to force water out on the same principle as a filter). The fry will hang close to the inlet to consume the delicacies which constantly enter their tank.

## HOW MUCH TO FEED

The proper food is most important; the amount fed is important too. Almost every beginner overfeeds and so pollutes the water. Guppies can be kept successfully on one feeding a day but to get the best results from them, two feedings are better and three are best.

The chief reason so many fanciers fail to raise guppies to their best is because they do not feed often enough. The period in which their digestive tract fills and empties is short. Any healthy guppy will eat ten times a day.

It is the person who feeds his charges as often as they will eat but not enough to foul the water, who gets the best out of his stock. That is why self-feeders are so useful, and why live foods seem to be so good for guppies. As we have seen, the live food is composed largely of water, but the guppy can handle it by rapid digestion. Dry food, or paste food, they will manage well too but there is always the danger lurking that these foods will pollute the water, and we all know they do require that we siphon more frequently than where none is fed.

However, they have their place, provided all the possible accessories are furnished to remove the surplus—filters, frequent stirring of gravel, snails, cat fish. And all of us who have used them realize that guppies can be raised on them to the exclusion of live food.

Their proper use is in frequent small feedings. When you feed, don't just drop a big pinch on the water's surface, but bend down and look up at the surface. You will be amazed at the large amount of food a small pinch seems to be, when viewed from this angle.

The amount fed depends upon the number of individuals in an aquarium. A good general rule is to feed in the form of live food only the amount you learn, from previous feedings, the fishes will consume in ten minutes. If you feed dry food, the amount the fishes will consume from the surface in two minutes is enough. Always keep in mind the dry ingredients in a food.

If you have polluted the water by overfeeding, change the major part or give an added amount of air or dissolve a small amount of aureomycin in the water (50mg. to 5 gallons) to kill the bacteria.

## CHAPTER V

# Heredity

TO ATTAIN WORTHWHILE RESULTS FROM GUPPY breeding you need to adopt the scientific attitude. Every scientist is a doubter interested only in learning truth insofar as truth can be ascertained. He is trained to employ critical judgment. He is never bent on *proving* some statement or supposition of his own or another's; he is interested only in *testing* it. He often makes mistakes; is found by later research to be wrong. This he welcomes for he is trying to add to the sum total of human knowledge.

The trained scientist has a mind which works in a fashion opposite to that of the lawyer. For example, one lawyer in court tries to *prove* one side of the case; the other the opposite. So they become trained in *proving* something. The scientist *tests* a proposition. He does not attempt to prove it right or wrong, but collects all the facts on both sides of the question, puts the plus-facts in one column and the minus-facts in another, and when he is finished, says, "All the facts I can find tend to show that this is the case." He does not care who originated some idea—George Washington could have first thought of it—he wants to know if it is true. He does not care whether hundreds of millions of persons in the past and a hundred million today believe that acquired characters are inherited. He says, "Where's the proof?" Not until scientists doubted and questioned did the flat earth become round, or a heavy weight and a light weight fall at the same speed. For hundreds of years everybody believed that a horse had thirty-six teeth and nobody dared doubt it until a person with a scientific mind opened a horse's mouth and counted forty-two.

So, adopt the scientific attitude. Try not believing anything you have heard by authorities until facts satisfy you by indicating what they say to be true. Nor can you use what somebody said in place of facts. That is only opinion—sometimes nothing more than the result of hallucinations. Facts and figures live. Accumulate facts and figures! Write them down, discover new facts. A whole new world will open itself to you—you will have access to a happier and a fuller life.

## BREEDING

One way to improve guppies is to mate the best male to the best females; that is generally the way nearly everybody does it. But if we are to understand what we are doing, we must know first some of the terms of the student of heredity —the geneticist. Many geneticists get more enjoyment from their work than students in any other field of science.

It is usually difficult for boys and girls (and grown-ups) who have had no training in biology, to grasp the principle discovered by Johann Gregor Mendel and now called Mendelism. This is possibly because the scientific terms used by the instructor when explaining the principle are not, but can be, put into everyday English so that the theory of Mendelism can be understood by all.

There are a lot of old wives' tales and nonsense about heredity which most older persons must unlearn before they can properly understand the latest findings of science. Here are some of them:

***Inheritance of Acquired Characters.*** If a fish tends to change its color to resemble its background, and this accommodation goes on generation after generation, there are those who say that the acquisition of the acquired shade will be inherited. It will not. This is an acquired character and acquired characters do not impress themselves on the germ plasm.

***Birth Marking.*** If a pregnant mother fish became frightened, even terrorized, until she hid all the time, our forefathers would have said that she would have marked her germ plasm or her embryos, and they would be naturally frightened. This is not so. Her being frightened would not mark her offspring. Every piece of research aimed at studying the problem has given only negative results.

***Telegony.*** If a female live-bearing fish is mated to an inferior fish once and bears three or four litters, and the female is afterwards mated to a male of excellent type, the first male cannot influence the offspring of the second. Our ancestors thought it could.

***The Blood Theory.*** We talk about blooded, pure-blooded fish when we mean highly bred or purebred specimens. The word blood is used mistakenly in place of the word heredity. This is a mistake and gives those who use it and those who hear it the idea that heredity is a case of dilution. Consequently it is difficult for them to grasp the fact that heredity is a case of presence or absence and not one of dilution. When you mate a grey guppy with a pink-eyed white (albino) you do not get a light grey but one like the grey parent. When you cross a gold with a grey you do not get a mixture; you get grey. There are few instances indeed, where the result of crossing involves single traits which give blends or dilutions, and none so far discovered in guppies. So it is better not to use the word blood when we mean inheritance—use terms such as pure-bred, breeding, heredity.

How then do guppies inherit? Is there a formula? or is inheritance helter-skelter without rhyme or reason? There is indeed a pattern no different from that of all other creatures.

### THE GERM PLASM

Within the body of every guppy there is a small group of cells placed in a protected position, for which all the rest of the fish exists, called the germ plasm. In this respect also, the guppy is no different from other creatures, including ourselves. The germ plasm is not created by the fish; it creates the fish. He or she is only its custodian. Each generation springs from this most precious of all things in the world. Every feature about the natural guppy is but a trick of nature to see that the germ plasm goes on and on, always becoming better and better adapted to the environment. Improvement to us may mean greater beauty, longer fins and often features which make the fish actually more and more unadapted to its environment. But our fishes are our toys, our pastimes, and since we have created unnatural objects we have a duty to protect them, because they need greater care than the natural guppy.

### MUTATIONS

But how do fishes constantly become better adapted to their environment? Through the ability of the germ plasm to make sudden changes which breed true. Such changes are *mutations*. And one of the most fascinating facts about guppies is that mutations occur so frequently. Think of all the species of animals and plants you know. What one shows so much variety? Then remember that the variety is the result of just so many mutations. Pigeons and parakeets compare with guppies in this respect, but guppies far exceed them.

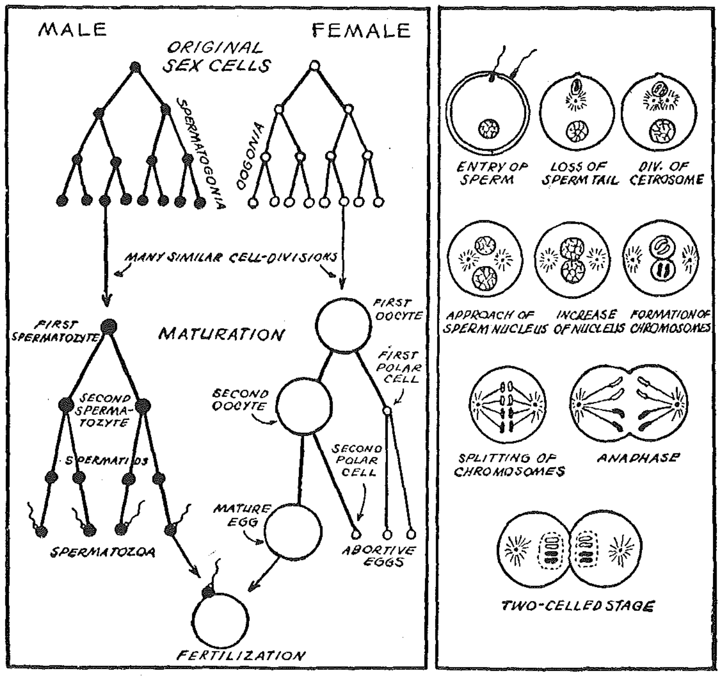
If mutations have occurred in the past so frequently, they will do so in the future also. Therefore, in breeding guppies, one is not up against a stone wall as one is in the case of other fishes which seem never to mutate. Having established a strain, one can hope for improvement by watching for new changes, which breed true.

Observe a lot of wild guppies. Compare the best with one of the fancy type. It makes one wonder at the vast changes. But now we know how it is possible. Let us say you decide to breed a strain with a black sword tail. After several generations of selection, you feel you have done the best that can be done. Then presto! you find a male with a tail twice as long as any you have bred. He is used to father the next lot and you find that the new long tail feature is inherited. So, step by step, you carry your strain ahead.

Of course you may find mutations in the stock of other breeders and obtain them to combine with yours, and you will share yours with persons who want your type.

We have considered the formation of the sperm and ova and the transmission of sperm to the female's tract. Now let us see what happens to the male and the female cells during their formation. If you understand this, you will find it quite easy to understand more about the basis of heredity.

The germ plasm is composed of cells which contain the heredity of the fish. If you study these cells, as they are going through the process which eventually produces the sperm and ova, you will find within the nucleus, a web-like substance which looks like network. This is chromatin, composed of many tiny packets of chemicals. You will see the chromatin become organized into pairs of lines or spherical groupings and if your microscope is sufficiently powerful you will see that the lines or groupings are made up of a large number of globes which are held in place or position by something we cannot exactly distinguish. The little globes are called *genes* and the lines or groupings they form are *chromosomes* (color bodies). They were so named because when the cells are subjected to certain dyes, these bodies take up the stain and show up quite clearly. Each species of living organism has its characteristic number. Fruit flies have four pairs, human beings, twenty-one pairs, guppies, twenty-three pairs.



Left, development of male and female cells from primary germ plasm, Right, fertilization and cell division showing how chromosomes behave.

When the ova and the sperm are formed, a most ingenious plan is put into operation to reduce the number of chromosomes so that each new generation will not have double the number of the last. It is accomplished by each sperm having half—one from each pair—the normal number of chromosomes. So when the sperm and egg combine the fertilized egg will have a chromosome from each parent to pair up and in the aggregate, twenty-three pairs. The egg retains its two pairs of chromosomes until just before fertilization when it casts off half in a little body.

This is wonderful indeed, because the fish's heredity is all contained in such a tiny cell—all the architectural plans for its development.

If you have observed carefully, you now realize that the genes are in pairs. All the genes operate to produce the characters we see in the guppy. The difference in any one pair can make a lot of difference in the fish. Geneticists (students of heredity) are always trying to factor all species into their genetic factors; the traits we see in the living animals. Then they make maps of the chromosomes and can tell you where the genes for each characteristic are located. In the fruit fly, geneticists have mapped dozens of traits.

A number of students of heredity had noted that in flowers, vegetables and even dogs, when two different traits (one from each parent) combined in an offspring, it showed one of the traits of one parent but not a blend. Galton noticed that when he mated a black-and-tan Basset hound with a black, tan-and-white, the pups were all black-and-tan. Mendel noticed that when he crossed tall garden peas with dwarf peas, the offspring were not intermediate, but tall. So the term *dominant* originated. One of the characters was dominant; the other receded from view—it was *recessive. But, it was there in the germ plasm.*

Our forefathers used to talk about traits "skipping a generation". Some do. How do you think it was possible by what you have just read? It puzzled all the early students of heredity. Galton noticed that when he mated two black-and-tans of his Basset hounds, each of which had had a tri-colored parent, that some of the pups came tri-colored—skipped a generation. If Galton had counted, we would today have been talking about Galtonism instead of Mendelism. The latter counted his peas. When he crossed two hybrids, that is two, each of which had a tall and a dwarf parent, Mendel found that the pea vines produced from such parents were in the proportion of one dwarf to three tall (no intermediates).

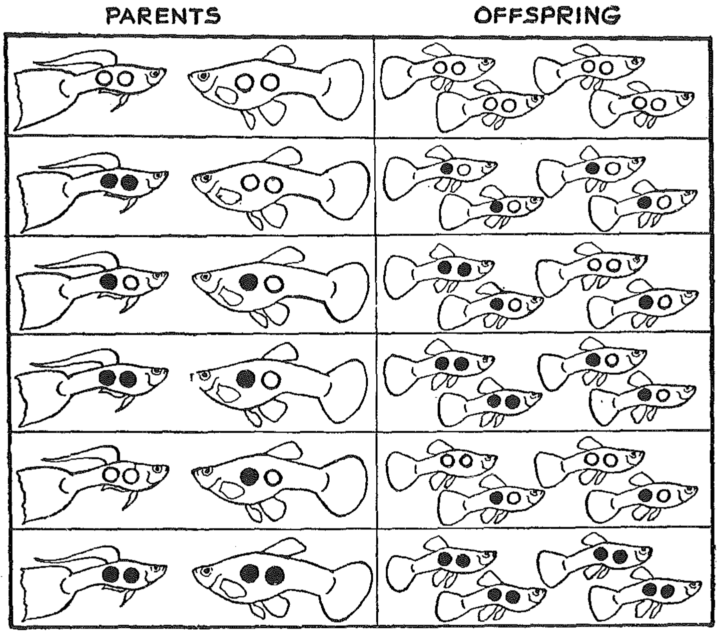
The dwarfs (the recessives) were pure; never produced talls. Some of the talls were pure and produced only talls but some proved to be hybrids and produced one dwarf and three talls. We can now forget Mendel and see what happens when we apply Mendel's findings with peas to our guppies.

Before we can make any predictions we must know which characters are dominant and which are recessive. Long continued breeding to study the traits has given us a partial answer and inbreeding to purify strains is essential. But we do know the mode of inheritance of some characteristics (see page 62).

Let us mate a pure wild type grey with an albino. All the offspring will be grey—*hybrid* for that one pair of characters.

Let us mate two hybrids—what do we get? twenty-five per cent albinos, fifty per cent hybrids, twenty-five per cent greys. Now let us see how this Mendelian ratio works out on the basis of genes. We shall represent the gene which produces the grey by a black circle, the one which produces white with a white circle. An albino has two white circles; a grey, two black circles. Now remember that when the sperm and ova are formed, the chromosomes halve, one half going into each of two sperm formed. So long as you keep this principle in mind, it is easy not only to see what happens, but to predict with every expectation of having your prediction fulfilled.

Continuing our discussion, let us see graphically what occurs in theory and practice when all the possible combinations of these genes combine to produce offspring:



The six possible ways in which individual characters may be inherited.

Parents at left, offspring at right. The white dots represent recessive, the black dots, dominant genes. Each individual with one or two black dots will appear like the dominant. A guppy with one white and one black dot is a hybrid, capable of transmitting the recessive character if it mates with another carrying that recessive.

## LINKAGE

In strains of guppies which have been bred for a long while the genes become established in certain definite places on the chromosomes. When the guppies breed certain traits always show up linked with others. A good example is the gold color with a small tail. A gold guppy with a large flowing tail was, before 1954 unheard of so far as I can determine. Another is the linkage of a lethal (killing) factor with yellow color which, as in the case of mice and other yellow animals, destroys the young in embryo. By count, the broods of yellow young are much smaller than young from closely related grey guppies in my strains—about twenty-five percent smaller.

The reason for the linkage is that the genes for those characteristics lie close together on the same chromosome.

### CROSSING OVER

This is a genetic term for the phenomenon of genes becoming reassembled in different combinations on a chromosome. When a pair of chromosomes form by the assemblage of genes, there may be different assortments, the chromosomes taking genes from each parent.

During this process, linkage is sometimes, though only rarely broken up. It was my good fortune to have such an occurrence produce a gold guppy with a huge flowing vein tail. By inbreeding this trait is now a fixture in one of my strains. And it breeds true.

### SEX LINKAGE

In the guppy we are greatly handicapped by not knowing what of the most admired characteristic the female carries. The early students of the fish indicated that all the admired characters lay on the Y-chromosome and it did not make any difference what female was used, as the male offspring "took after" the male. Now what did they mean by the Y-chromosome?

### THE SEX CHROMOSOMES

One pair of chromosomes are uneven or unequal in size. All of the lovely characters of color, length of tail, dorsal fin, shape of tail, abide in the male, so it was natural to suppose that the genes for these traits resided on the chromosome which had no adequate mate to dominate it. But the early geneticists covered too much ground. It is true that the uneven pair do account for sex. Suppose that one chromosome which we call X is a little one and its partner, which we call Y, is a big one. If an egg has two of the X-chromosomes, it becomes a female, but if it has one X and one Y, the combination of XY produces a male. That is why there are approximately an equal number of males and females born. Half of the male sperms contain X and half contain Y. Every female sperm contains XX. The possibilities therefore work out to be fifty per cent XY and fifty per cent XX—half male and half female.

In some species there is a large size difference between the X and Y chromosome; not so in *Lebistes.* In studying the chromosome appearances with a microscope, one finds every partner in each chromosome pair to be alike.

One student has attempted to map chromosomes. He thinks that of the eighteen genes which affect color markings, several affect the shape of the tail as well as body colors. Some gene effects are recognized only in the male although they are carried by females. Sword tail is one of these characters. Females are not seen with swords but the characteristic is there undeveloped probably because of repressive hormonal influences. Until this fact is recognized, one cannot really understand Mendel's law as it works in guppies.

At least nine genes are located on the Y-chromosome, but some, during the process of cell division, become incorporated in the X-chromosome; that is, some of the X and Y genes exchange, a process known as *crossing over.*

X-ray irradiation interferes which normal inheritance in guppies by affecting genes and chromosomes. Recent studies of radiation effects when atomic stock-pile elements were used produced death in the fishes before any radiation effects were observed. Future studies may yield surprising results.

### SEX LIMITED CHARACTERS

We must distinguish clearly between sex-linked and sex-limited characteristics. As already pointed out, geneticists have placed so much emphasis on the gene characteristics which are located on the Y-chromosome that almost everyone now believes that to obtain super guppies all one must do is to obtain a super male; that the female plays but little part in passing on the more cherished features. This is only partly true. The characteristics produced by genes on the Y-chromosome are *sex-linked.*

The beautiful plumage of a male chicken is quite different from the hen's. Is it sex-linked? No. If the young chicks of both sexes are caponized, the resulting mature birds look very much alike. The capon looks like the hen, the caponized female chick looks much like the capon. These particularly masculine and feminine characters are determined by glandular secretions—hormones—and are *sex-limited.* What sex-limited characteristics do we find in guppies?

There have been few studies which help us much. Female guppies which have been masculinized by hormone treatments cannot exhibit any features which their female genes cannot develop. All they can show are characteristics which their female hormones have repressed. A number of male-like features show up, and all of these are evidence that such are not on the Y chromosome. The beautiful colors now being bred on female guppies' tails are not functions of the Y chromosome. Indeed the plainness of the female is partly due to hormones which restrict some of the beauty from appearing. Male hormones fed to partly grown females inhibit their growth.

The cessation of growth in males at the time they reach sexual maturity is a sex-limited character. When treated with female hormone, they grow much larger.

## SEX HORMONES

Anyone wishing to experiment with sex hormones will do well to review the literature recorded in the bibliography. The results so far reported in brief are these:

Feeding the female hormone (oestrone) to both sexes of fry and older guppies, hindered growth and depressed the growth of females. In males the size at sexual maturity was increased. In older males their growth was enhanced but male coloration was lost.

Feeding the male hormone (testosterone) depressed the growth of all young fry. Growth of partly grown females was enhanced.

In yet another study, *pregnenalone* was fed in tablet form. It fulfilled the expectancy for an androgen (a hormone which controls the sex characteristics of males) better than testosterone proprionate. When fed to immature guppies from birth on, it completely prevented development of female secondary sex characteristics and caused early development of male secondary sex characters. It induced earlier-than-normal development of germinal elements and when given over a long period of time, destroyed the testes.

Testosterone had similar effects but not as marked. In males it inhibited male red colors from developing, just as female hormones had been found to do.

Thyroxine, a thyroid gland product, produced, in one study, larger guppies which required a longer growing period to mature. In males the thyroxine-treated individuals became about ⅐ larger but continued growing for nearly twice as long. In another study of putting synthetic thyroxine into the water, and feeding powdered thyroid gland, no changes could be observed.

## INHERITED CHARACTERS IN GUPPIES

With the introduction of sex hormones some of the early conclusions of geneticists must be discarded. As already pointed out, many characters in females, had they no female hormone to repress them, would show up as male. Sword tail is a good example. One investigator tells us the character is "absolutely Y-linked" (sex-linked and located on the Y-chromosome). Now we know this is not necessarily so. To read this early work, one might conclude that only one pair of chromosomes was of much consequence in guppies—the X and Y—but there are 22 other pairs to reckon with. The early work mentions only yellow, red and black, and occasional blue spots on the body, as if there were no other guppy colors. Yet we know that even on gold males, it is common to see brilliant green patches. Blue-tailed guppies are a favorite color type among fanciers. Some of our lovliest guppies are of this variety. A great deal remains to be learned. Perhaps you will be one to add materially to our knowledge about the fish's inheritance.

Further scientific study will alter the present conception of the dominant and recessive characters of guppies but the following is the best compilation which we can make:

| *Dominant* | *Recessive* |
|---|---|
| Wild grey | Gold |
| Wild grey | Blond |
| Gold | Blond |
| Wild grey | Albino |
| Lack of sword tail | Sword tail |
| Rounded end of tail | Square end of tail |
| Rounded end of tail | Superba type of tail |
| Normal color | Black spots in fins of females |

The geneticist who has described more color characters and their inheritance than any other person is Winge, the Danish geneticist, who gave each color type a name and from breeding the fishes estimated on which chromosomes the genes were situated. Winge described the color effects produced by each gene and named them. Some he thought were located on the X and some on the Y chromosome. He reported some hermaphroditic fishes which, while they looked to be intersexes and had some color, behaved like females and produced young. But Winge did not use sex hormones to determine which characteristics were *sex-limited* —an all important device employed to differentiate between *sex-linked* and *sex-limited* inheritance. He described in all 18 color pattern characters.

Results of color crosses sometimes surprise one. When a gold is mated with an albino, the result is neither gold nor albino, but wild grey. This is due to the fact that the offspring each have only one gold gene and one albino gene, but it takes a pair of each to produce a gold offspring or an albino respectively.

Genes called modifying genes doubtless are present to affect the amount of color shown, the size of spots, the size and shape of fins; indeed, the size of the guppy. Their number or dominance or recessiveness have not been determined.

## INBREEDING

Almost every article about guppies tells us that all the males are so unlike one another that no two could be found which could not be told apart. These authors could never have seen inbred guppies.

Such guppies are the only safe kind to use in studying heredity; practically all others are unreliable for it is too easy to draw unwarranted conclusions when using them. And guppies are unusually rugged in this regard, standing inbreeding remarkably well. The same precautions must be taken with them as with any other species. From each generation, the largest and the most vigorous must be chosen to be parents of the next. Inbreeding simply concentrates the characteristics. If there are a lot of inferior features they will become congregated in a single fish and probably produce an inferior fish—by the same token, the good are also congregated. Each generation is a little less prolific. In my inbred guppies, each generation was a little smaller and a little less vigorous down to the fifth, and from there on, an improvement occurred. Our tenth generation inbreds have better guppy characteristics than the fifth, but not as beautiful as the one with which we started.

### OUTCROSSING ESTABLISHED STRAINS

First, what is a *strain of guppies?* It is simply a group of fishes with similar assortments of genes or chromosomes in a fairly definite arrangement.

What happens when outstanding guppies from two established strains are crossed? Frequently retrogression. We have crossed the best there are and have never seen one case of guppies as good as these unrelated parents. Why? The gene assortments are not the same and the new chromosomes fail to produce the desired appearance.

***Inbreeding—Outbreeding.*** The best corn, hogs, chickens and now guppies are the result of outbreeding two unrelated inbred strains—inbred for seven or more generations. The flashy, large and most sensational guppies of the future will doubtless be of this kind. Unfortunately such guppies are of little value for breeding purposes because their offspring are decidedly downward in the scale. The practice rests on hybrid vigor—*heterosis.* The system has the advantage of preventing competition.

Hybrid vigor will produce giants but on the basis of my early experiments, not beauty. I inbred one strain for eight generations, another for six and then mated a fish from one line with one from the other. The resulting guppies were probably the largest ever grown. One female measured three and a half inches long. But the males were drab, colorless individuals with large tails, because the males were large, yet the tails were not particularly large in proportion to body size.

It became obvious therefore that in the case of guppies, bred for certain characteristics, it is necessary to start with related strains which have been demonstrated to cross with excellent results, and inbreed these fishes brother to sister for many consecutive generations and then outcross them. This method does produce both large and beautiful guppies.

Moreover, for those interested in studying genetics, it produces pure strains of extremely similar individuals.

***Line Breeding.*** Mating closely related animals is line breeding. The relationship of line breeding usually considers relatives further removed by inheritance than first cousins. Line breeding is safe and has none of the disadvantages of inbreeding. It is used principally in conserving valued characteristics.

## CHAPTER VI

# *Practical Guppy Breeding*

FROM THE FOREGOING YOU HAVE LEARNED ENOUGH of the simpler principles of genetics to enable you to see how to improve your stock. You have seen that inbreeding, coupled with rigorous selection does no harm in the long run. Because guppies today are such a jumble of unit characters all within the same strains, it really requires some generations of close inbreeding to fix a strain. Even in studying guppy genetics, it is necessary to inbreed to eliminate confusing traits.

***Control of Breeding Stock.*** Perhaps one might call them tricks, but the following highly practical ideas will help any neophyte.

Guppy improvement must take into consideration the fact that one mating of the female can last for a number of litters of young. The male sperm lie dormant awaiting the production of a new lot of eggs and fertilize them. If a mating is made right after the production of a litter, the fresher sperm are able to take over. For example, one of us mated an albino female to an albino male. She had a litter of twenty-one young. I introduced a grey male and all of her next litter were grey. The same occurred in the case of gold females. A grey male was placed in a tank with six golds which had previously been mated to gold males. Each had a litter of golds and thereafter, litters of greys.

It is therefore necessary to be absolutely certain that the females are mated to the male we want to be the sire. How is this accomplished? By early sexing.

***How to Sex Guppies.*** Sexing means separating the males from the females. This is a simple matter in partly grown but difficult indeed in guppies too young to breed. Nevertheless, it can be done.

Use a strong light. At one day of age, if a one-hundred-watt light is held over the babies, a dark spot can be seen in the females which is lacking in the males. Because of the delicacy of the little ones, separating them at this time is a difficult matter. It is better to wait until the development of sex features enables one to recognize the male's gonopodium and the large anal fin of the female.

The small container holding the fishes may be held at eye level and one by one, the females removed to a separate container. It is not necessary to separate all of them; only enough to be useful for breeding stock. If a dozen are removed, they could, in one spawning of young, produce a total of over two hundred in their first combined litters. If they are fairly large, the twelve could produce a total of six hundred young, if most of them are saved.

Another help in recognizing young females is by the small triangular black spots which appear very early, at the junction of the tail with the body. In some of the most beautiful strains, the males never show such spots.

A magnifying glass, when the lighting is good, can be a wonderful help, but persons with normal vision can, with a little self-training, learn to distinguish the sexes with amazing accuracy. If the segregated females are placed where they can be watched, and if you have made a mistake, you can see one's male characteristics developing, and remove him before he has become old enough to mate. One such mistake which may ruin a large number of very valuable females. A male may develop with a completely colorless small tail and but a small amount of color on the body. One may look for color instead of the gonopodium and miss this single male until it is too late.

***Mating.*** Some breeders place all the males together with no females in the tanks, contending that they grow larger and faster. Others think that it makes no difference if a few females are allowed to remain. The females are usually sold along with the best males at fancy prices, but the chances are they were bred by the males which were closest to the natural wild guppy, rather than by the best.

As the males in your tank develop, watch them and determine which ones you want for the sires, segregate them if necessary and when they have developed further, choose the best for mating with the females.

A word of caution: do not wait until the males are fully matured and in their prime to introduce them to the females. It is possible and in fact likely to develop our males into such unnatural fishes that the long tails and flowing dorsal fins become a hindrance to their ability to fertilize a female. Many a fancier has bought the best of another's stock only to be disappointed at having none of its progeny.

This is not imagination but occurs frequently and is based on experimental evidence. For example, three males—all brothers—of the Earl strain, each having a tail longer than his body, were completely unable to fertilize when they were a year old, but had been fertile at nine months. Several Superba strain males were useless as breeders at fourteen months of age. Hahnel males have lasted longer. One albino male with an uncommonly long tail was useless until the last half of his tail fell off, when he again became a father. It apparently is not age, so much as the dragging and retard-ing effect of the beautiful but, to the fish, ungainly tail. Two sixteen months old beautiful ribbon tailed males were placed in a tank with eight virgin females. Not one was impregnated.

What then is the solution? Use the best young males. Out of every tankful some stand out far in advance of the rest. The difference will generally become accentuated as the lot grows older. Those which show the best development early will be the best looking guppies when all are mature. Colors change somewhat, but those with brightest early hues will also be brightest when mature. So you can generally tell which are your choices and these males will be fertile until their long tails become encumbrances.

***Selection of Breeding Stock.*** As already mentioned, old, fully developed males are not always fertile, or able to complete the sexual act efficiently. Yet, the old, beautiful exotic males are what any neophyte would naturally buy if he has his choice. They are poor bets as foundation stones. Mature females too are unlikely prospects unless one knows to what males they have been bred. To walk into a fish store and buy some large females is all right for those wanting to own guppies, perhaps to learn about them first hand. But to start in the guppy hobby with the intention of breeding exotic fishes of a certain type, that way is senseless.

It would be better to visit the aquarium of a famous breeder and buy one immature female from his best stock if he or some other breeder will agree to mate her to the male of your choice, than to buy a hundred nondescript females and a lovely male. Following the first course, in four months you would have a tankful of top guppies; following the second, you might have a few good ones.

On the other hand it pays to scrutinize fish store tanks for mutations, especially in females. The Earl strain came from a female mutation whose tail was pointed far backward at the top, but whose body was slender and long. She was lacking in fecundity, never bearing over twenty young in a litter. However, by mating her to her son, the strain was established, and by inbreeding, fixed. According to the originator of the Superba strain, the same thing occurred and the same method was used to establish or fix the strain.

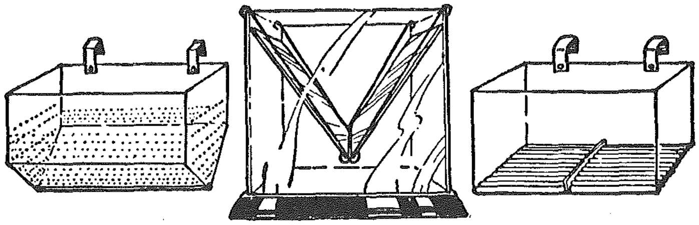
Occasionally dealers import guppies with the idea of obtaining better stock on the assumption that our domesticated fishes have degenerated. But what a mistake! All we have written about the importance of the utmost care in selection should convince anyone that fishes which breed helter-skelter are always regressing toward mediocrity. Our guppies are so far ahead of wild ones that they seem like different species.

***Guppy Crops.*** The serious breeder does nothing hit or miss. He wants a large number of babies to be born near to a given time. He wants them to grow up together so he can choose the best males and market a fine uniform crop of the balance. Fish stores do not want a mixed-up lot and they do appreciate say fifty uniform males with fifty females to sell by the pair. If the fishes are uncommonly fine, they are started off at perhaps ten dollars a pair. After half are sold, there will continue to be some improvement in the remaining fishes and perhaps thirty pair will sell for a high figure. Then, to dispose of the less valuable ones, the price is dropped and the remaining guppies may be put into a tank with cheaper stock.

It is quite easy to arrange for such a crop. If the male is placed with well-grown virgin females, and left for three weeks, by then most of them will be showing pregnancy. Each one, whether she shows it or not, can be placed in a gallon container and within two weeks all will have spawned and a large crop will be ready.

The greatest advantage of the crop is in the realm of feeding because then a baby food culture can be prepared and thrown away when the little guppies outgrow the need for it.

***Preserving the Young.*** Unless a mature guppy is so stuffed with food that it cannot hold any more, it will eat young guppies. And some seem to relish the tiny things above food of all other kinds. If guppies are to be raised efficiently, some provision must be made to prevent their being eaten. Traps out of which the young can dart, but from which the females cannot escape, prove useful, but few more efficient devices have been invented than the use of plants. There are plants like nitella which hold back mothers but not babies. Hornwort filling a container is excellent. One breeder will use only najas. An excellent substitute is dried, sterilized and washed Spanish moss, at sale at fish stores under several names—dried breeding grass, for example. If it is placed in a container with only a small amount of room left for the mother, nearly all of the babies will be saved, provided, of course, that the mother is removed as soon as possible after she has completed spawning.



Three kinds of breeding traps.

## CHAPTER VII

# *Guppy Diseases and Ailments*

THERE ARE MORE DISEASES TO WHICH THE GUPPY IS heir than is commonly realized. A tankful of the fishes may go along for a year or more maintaining its numbers, the owner oblivious of the fact that disease is killing some of them. Snails may consume the dead. But then, there are also obvious diseases and without doubt deaths from ailments about which we, as yet, know little or nothing.

With the advent of sulfa drugs and the antibiotics, a new era dawned in the control of fish diseases in general and some guppy diseases in particular. A number of medical discoveries now help us prolong guppy life many months beyond the old average age of our *Lebistes.*

Does it pay to try to cure a sick guppy? In the case of one average fish, probably not; in the case of an especially valuable specimen, it definitely does. In the case of a tankful of guppies, all infected or doomed to become infected, with the same disease, it pays well.

How can one tell that a guppy is sick? In many ways of which the following are only a few of the more obvious:

1. Loss of appetite.
2. Inability to eat, though manifesting hunger.
3. Shrinkage in size, especially from top to bottom.
4. Drooping of fin and tail clamping.
5. Loss of interest by males in females.
6. Shimmying.
7. Hanging close to surface of water.
8. Lying on the bottom.
9. Swimming or darting crazily about.
10. Curling tail toward head.
11. Swimming straight up and down.
12. Swimming on one side.
13. Appearance of white spots on body.
14. Appearance of whitish area on fins and tail.
15. Appearance of fungus on body.
16. Redness of gills.
17. Holding mouth open.
18. Spongy growth in mouth.
19. Giving birth to immature young.
20. Loss of color by males.
21. Excessive darkening of pigmented areas.
22. Sudden dying of a number of fishes.
23. Lumps developing on body.
24. Ballooning of body.
25. Distended eyes.
26. Development of deformed bodies.
27. Discoloration in spots on bodies of females.

In short, any unusual behavior or appearance may be an indication that something is wrong. The oddity may become evident shortly after the introduction of a new fish, a new lot of water, new plants, or after feeding tubefex or daphnia. It may be traced to new snails if some have been recently placed in a tank or even a turtle put there to eat snails or a catfish introduced to eat excess food or algae. Then again, a disease or parasitic infestation may seem to occur spontaneously. Yet such a thing does not occur. Perhaps it is a slowly developing disease or parasite which started from an infection so long ago we have forgotten how it did start. The main thing is to know how to cure it and to prevent its spread. This we usually cannot do unless we know the nature of the disease. Hence we now consider the common guppy ailments, their causes and most effective treatments.

You will find the details for carrying out these treatments on pages 98 through 111

### POISONING

The most common killer of guppies is poisoning. We saw in Chapter III that they can live in water considerably polluted but there is an end point to everything. Often it is impossible to know the nature of the poison. Water with minerals which kills guppies, poisons them. Water running through long lead pipes can kill them insidiously as it has killed human beings. Copper pipes, too, are often lethal. Copper in a concentration of 0.2 parts per million parts of water will kill some fishes in twenty-four hours. Such small amounts of copper as to seem inconsequential have been found to destroy infusoria and other minute food on which the fry thrive. Water too acid, too alkaline or too salty may be lethal. Fresh water from a tap from a city supply may kill due to its high chlorine content. Some spring water, much deep well water is unfit for them to live in. Improper water has certainly been the cause of more deaths to guppies of persons in my acquaintance than any other cause. Improper aquarium cement has killed many fishes.

***Food Poisoning.*** This is another common cause of death to guppies. Overfeeding produces fermentation and decomposition; where insufficient aeration is afforded the toxins elaborated by the bacteria growing in the food kill the fishes.

***Carbon Dioxide Poisoning.*** Overcrowding probably accounts for this fate. Too much carbon dioxide given off, insufficient plants and light to turn it into plant growth, no aeration to help with the carbon dioxide exchange in the water, and death ensues. In this condition, the fishes usually hang close to the surface before they die.

While it is true that guppies will stand extremes of environment and live, research has shown that they will not breed when the carbon dioxide content of the water is high. This is why the breeding slackens or ceases in crowded tanks. If it is desirable to produce young every effort must be made to keep the $CO_2$ at a minimum. The gravel especially, must be clean so no bacterial decomposition can go on, there should be generous aeration, no over feeding, many plants and as few breeders as you can get along with.

***Dying Plants.*** Under certain conditions, decomposing plants which have died, will kill guppies. The water may take on an especially acrid odor, pervading the room in which the tank is kept. The least abnormal odor from the water should set the fancier searching for the cause. Algae, being plants, will kill guppies if enough die at one time.

***Spray Materials.*** Fly sprays about the home have killed myriads of fishes. One of the insect killers, rotonone, will kill guppies even in a dilution of one part in 13,000,000 parts of water. Others are just as deadly, so it is fatal to wield a fly or mosquito sprayer in the same room with the guppy tanks. In out-door pools, the killing of fishes by dogs covered with flea powder, swimming in the pools, or by poison dust or sprays used on bushes or flowers in the vicinity which blows onto the water's surface, have accounted for large losses.

Soap and disinfectants not rinsed out properly after washing tanks will kill fishes. Cleaning glass with improperly washed copper cleaners which previously have been used in connection with soap or scouring powders is a dangerous practice. Even one's hands are suspect. Fishes have been made sick by their owners reaching into an aquarium without washing their hands after they have handled bug poisons or powdered their dogs or cats with fleapowder or cleaned them with a "dry bath".

***Drugs and Doses.*** These are the drugs we have found useful and the doses or methods of dosing guppies.

***Salt Treatment.*** Dissolve a tablespoonful of salt in a gallon of water and place the sick fish in it. Next day add another tablespoonful of salt. Next day add another. On the third day remove half the water and replace it with fresh. On the fourth day repeat this process and on the fifth return the fish to its tank.

***Salt and Epsom Salts Treatment.*** Dissolve two tablespoonfuls of ordinary salt and two of Epsom salts in a gallon of water. Leave the fish in it for four to six hours. Then add another gallon of water and leave the sick fish in this weaker solution for twelve hours before returning it to its tank.

***Copper Sponge.*** Simply place a non-medicated copper sponge in the tank. If the fishes get too much copper, and there is sufficient aeration they will start hanging near the top. This is a signal to remove the sponge and part of the water which you replace with fresh.

***Tincture of Metaphen (1:1000).*** Add two drops to each gallon of water.

***Mercurochrome.*** Add one drop to each gallon of water.

***Formalin.*** Use 8 drops to a quart of water.

***Hydrogen Peroxide.*** Used as a daub, the fish is held in a damp net and the peroxide dropped on the affected spot with a medicine dropper or squeezed out of a piece of saturated cotton or wool, taking care not to get the drug on any but the sick area. Let the peroxide remain on the spot for ten seconds. Keep it out of gills.

Used as a solution for immersing guppies, it is mixed with water half and half. All the guppies from a sick or infested tank are gathered into a small net together and dipped into the solution where they are held two seconds and at once returned to their tank. Only very weak ones succumb. This is a drastic cure. Use it at your own risk. Try it on a few first to assure yourself of the efficiency and safety. It is not recommended for other species of fishes.

***Heat Treatment.*** This consists of raising the temperature of the tank to eighty or eighty-five degrees Fahrenheit, and holding it there for several days after the fishes appear cured.

***Aeriflavin.*** Make a stock solution of 1 grain to 8 ounces of water. Use a tablespoonful of the solution to 5 gallons of water. No need to change water unless fishes hang on the surface.

***Tetracycline.*** Use the soluble form which comes in fifty milligram tablets. Dissolve one to each two gallons of water and leave it in.

***Potassium Permanganate.*** This drug which gradually disappears from the water is used at the rate of one-fourth of a grain per gallon of water. If the fish start to hang, change part of the water.

***Methylene Blue.*** If you have to use it remember it discolors the water and everything in it until it gradually oxidizes and disappears; add one-hundredth of a grain per gallon of water.

### FUNGUS DISEASES

Fungus grows differently from bacteria and the organisms which constitute this great group do strange things. Some turn into resistant forms called spores which wait for suitable conditions before they develop into the characteristic patterns. Others like yeast push out buds which break off and become organisms. The so-called myceleum threads of some fungi are most interesting because they produce the effect which we call mold—a thicket of such small threads, they appear like satin but are easily crushed flat. Some cover an area with growth and look like slime. Some fungi are motile, that is, they have whip-like appendages with which they propel themselves.

***Saprolegnia.*** If on the fish's body, a white, slimy, flattish patch appears which seems to have replaced a part of the fish's skin, it is probably saprolegnia.

*Treatment: Isolate the affected fish and disinfect the net.*

*Take your choice: (1) Tincture of Metaphen, (2) Salt treatment, (3) Heat treatment, (4) Hydrogen Peroxide as a daub, (5) Aeriflavin.*

***Mouth Fungus.*** A very common guppy disease, mouth fungus, kills millions of guppies annually. From a small whitish area which prevents the fish from closing its mouth, the whole mouth becomes filled with a spongy-looking accumulation and the fish dies. If you examine the cottony stuff from the mouth with a microscope, you find it composed of an enormous number of moving organisms. The growth not only occludes the mouth but etches away the tissue. The necessary steady stream of water through the mouth and out of the gills can no longer pass and this kills the fish rather than starvation. Affected fishes hang near the surface even in well aerated tanks.

*Treatment: (1) Aureomycin. (2) Mercurochrome. (3) Metaphen.*

***Crown Fungus.*** When you see tiny myceleum threads radiating upward and outward from a smallish spot, making what looks like a crown or miniature drawing of the sun's rays, it is probably crown fungus. The rays may grow an eighth of an inch long before they are brushed off.

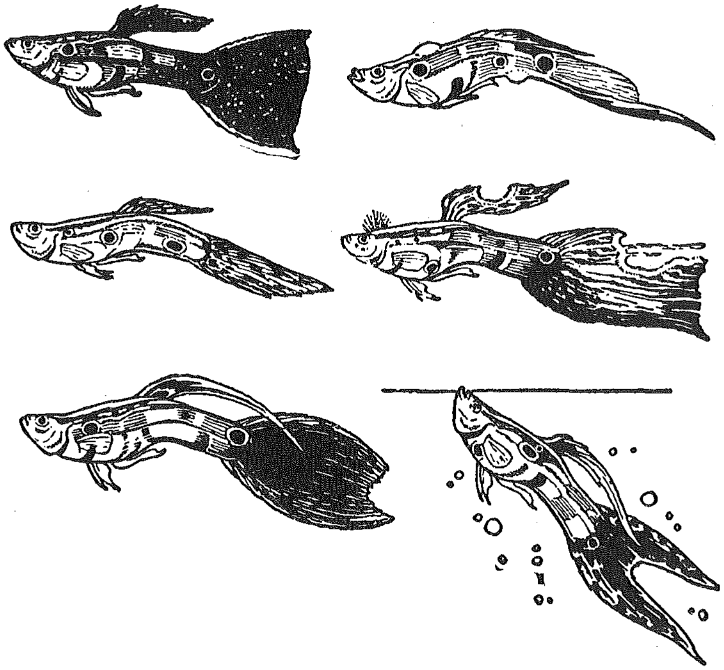
*Treatment: (1) Mercurochrome. (2) Touch spot with hydrogen peroxide.*

***Fin and Tail Fungus.*** Sometimes grayish or whitish areas appear on the fins and the tail, etching out areas and inter-

*Treatment: (1) Raise temperature, (2) Hydrogen peroxide applied directly to diseased areas, (3) Mercurochrome, (4) Metaphen.*

***Gill Sickness.*** Possibly gill inflammation is caused by many organisms. The gills appear redder than normal and the gill covers—the *operculi*—stand well out so the gills are visible. The progress of the disease is slow. In older fishes, emaciation occurs, the fish may eat, but not well, and it swims about in an apprehensive fashion. Small fry are killed quickly. Some experts believe the disease to be a virus, some bacterial, but the type which has affected my guppies has consistently been a fungus.

*Treatment: Since affected fishes are seldom thrifty even if they do recover, it seems best to destroy the diseased as soon as they show signs of the sickness. Treatments which have been tried and have not been successful in the gill inflammation among my fishes are aureomycin, penicillin,*



Signs of ailments. Upper left, "ich"; upper right, tumors and mouth fungus; center left, wasting from various causes; center right, crown, fin and tail fungus; lower left, saprolegnia; lower right, overcrowding producing lack of oxygen.

*terramycin, hydrogen peroxide. Yet some fanciers have reported miraculous results with antibiotics, an indication that there are several causes, some of which are killed by antibiotics and some not. (1) Metaphen. (2) Mercurochrome. (3) Potassium permanganate. (4) Give fishes some more room. (5) Try using chlorinated city water, leaving fishes in an hour at a time. (6) For large fry and adults, the salt treatment.*

### BACTERIAL DISEASES

***Tuberculosis.*** This disease kills more fishes than is realized because the effects are generally slow and fishes do not waste as do birds and mammals; they stay plump until they die. The germ, called *mycobacterium piscium,* has been found in many parts of guppies, even in the eyes. You are not likely to know if your guppies have the disease even when you find them dead. A bacteriologist can make the determination for you. Despite the fact that we keep so many guppies in such small places, tuberculosis does not seem to spread among all the inhabitants—if it does, it is quite rare.

***Bloat.*** When a guppy shows a roughened appearance from the scales standing on end, and it appears to be bloated, it may have an intestinal infection which distends its intestines so greatly that it cannot swim below the surface without great exertion. Some stay in an upright position.

*Treatment*: (1) *Epsom salt,* (2) *Common Salt.*

***Air Bladder Disease.*** Some fishes with air bladder ailments will appear to settle on the bottom of the tank and make violent efforts to rise, only to settle down again. Others, called floaters, rise to the top of the tank and are unable to swim down. Students of fish diseases tell us that inflamed organs can reduce the size of the air bladder. Inflammation of the bladder wall also exerts a disastrous influence.

*Treatment: Dissolve a teaspoonful of Epsom salts in a pint of water. Immerse the fish in it until it almost ceases its efforts to escape and lies exhausted. Then change the fish* *to a shallow container in which the water is not more than three times as deep as the fish is thick. Leave him in this water in which you have dissolved an antibiotic until he appears recovered.*

***Gas Bubble Disease.*** Bacteria which invade portions of the fish's body sometimes cause gas which produces lumps. The gas may collect behind the eyes and pop them forward. The exact cause is not known for certain, but successful treatments are.

*Treatment: (1) Aureomycin. (2) An old successful method involving the simple matter of placing the fish in a tank of long-used water. The high nitrogen content is believed to relieve the condition.*

***Shrinking.*** For want of a better name, fanciers often refer to the condition of a loss of size about the middle as shrinking. In farm animals, the livestock breeder calls it "tucking up." A fish seems to lose substance—the entire abdomen becoming smaller. The fish's bottom line becomes almost straight. Often one finds every female going this way. Unless something is done, the affected ones are soon gone. There may be many causes, including tuberculosis, for the condition, but in my experience most of the cases are due to too high acidity in the water.

*Treatment*: Correct the pH to neutral or slightly alkaline. Clean the gravel, if it is foul, to prevent further production of carbon dioxide.

### DEFICIENCY DISEASES

Except for vitamin D deficiency, very little is known about fish deficiency diseases. The very nature of their natural food almost warrants they receive all the known vitamins, but under artificial conditions they could conceivably have a deficiency. Mineral deficiencies are doubtless common, a fact we can determine knowing the inadequate diets often fed to guppies.

***Rickets.*** A disease caused by a deficiency of calcium or phosphorus or vitamin D; one, two or all three. A crooked spine and the resulting bend in the fish's body is the usual evidence, although the unfortunate humpback can live and even reproduce. It is not a pleasant sight among the fishes of the aquarium.

Proper lighting can prevent D deficiency; the active rays affect ergosterol in the skin of the fish and change it to the irradiated form which is vitamin D. Sometimes whole aquariums will show bent spines but generally only a few of the fishes are affected. There is no treatment; it is all a matter of prevention which is primarily a matter of proper feeding—feeding of a complete diet.

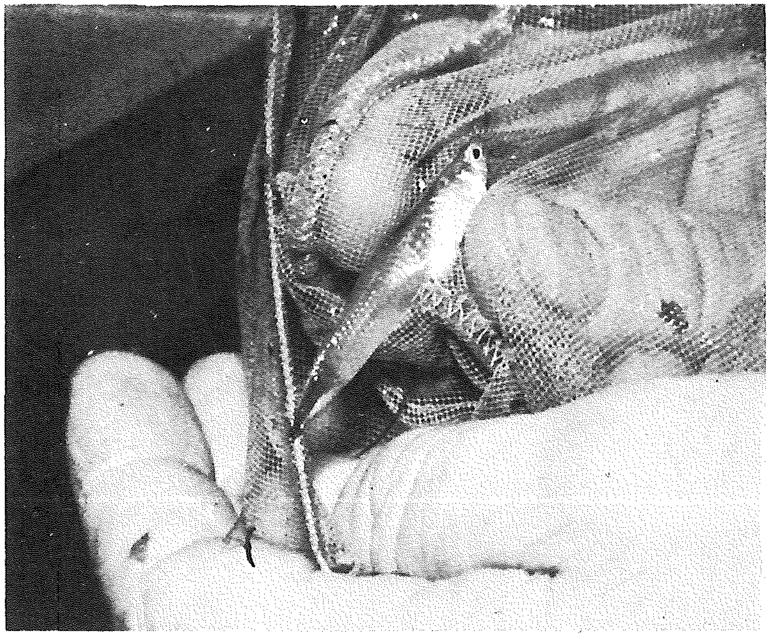
### PARASITIC DISEASES

In discussing diseases with several of the guppy breeders with longest experience, their greatest difficulties have been shimmies and "ich", both most often caused in *Lebistes* by parasites. Another has been troubled by *velvet* and another who feeds a great deal of live food which he collects from ponds, finds that *hydra* gives him no end of trouble. There is no uniformity of experience.

***Ichthyopthirius*** ("ich"). This microscopic protozoan parasite is named *Ichthyopthirius multifilis.* It attaches itself to the guppy and gets inside the layers or under the skin. There it produces a white spot—sometimes a great many white spots can be seen on one fish. After a few days—depending on the temperature, it emerges and falls to the gravel bottom, and becomes a cyst inside of which hundreds or thousands of tiny parasites develop, eventually released to swim about in this infective stage. ın this stage, they are able to live no more than ten days without nourishment and then only in cool water. So you almost never see "ich" on guppies kept at 80° temperature.

*Treatment: Raise the temperature to the 80°–85° range. Use any chemical treatment: (1) Metaphen. (2) Mercuro-*

*chrome. (3) Methylene blue will destroy the organism but blues the tank's contents. Among my own guppies, I have never had "ich" since a uniform temperature of 76°–80° was maintained. No treatment has been necessary.*



This is the way to hold a guppy in a wet net for examination.

***Ichthyophonus.*** Ichthyophonus disease is caused by a small organism, *Ichthyophonus hoferi,* which attacks principally the ovary but is also found in other parts of the fish; causes the fish to become emaciated with a shrunken belly, lose its appetite and move with shaky unnatural movements (not shimmy).

On post mortem the ovary appears to contain a large number of yellowish-white knobs up to the size of a pinhead which are frequently mistaken for tubercles as seen in tuberculosis. The knobs fill the ovary as small ones grow on the larger. In time, the knobs grow through the skin; if the fish lives long enough, these can be seen plainly. Affected fishes have been known to live many months.

So far as we can determine no cure is known. The best method of control appears to be to remove all victims at the earliest signs of the disease.

***Gyrodactylus.*** When guppies shimmy and when with careful observation you can discern a faint whitish abnormality on their scales, the chances are excellent that they have this tiny leech clinging to their scales and in their gills. This parasite has caused us more trouble than all other parasites combined and until cures were found for it, it made guppy keeping far less fun than it now is. An invasion of *gyrodactylus* causes a fish to shimmy his life away. It makes one shudder to realize what is happening, that is, when one knows the cause.

The parasite reproduces with great rapidity because of a curious fact. A young individual becomes sexually mature while still in its mother's uterus and inside of it may be another sexually mature individual and so on; four generations may be found, one inside the other. No wonder they multiply so rapidly.

The irritation they cause is by their hooks. Each has a large (large considering their microscopic size) pair of hooks with which to anchor themselves, and, around their bases, sixteen marginal hooks. The body moves about standing upright from the base. It can elongate or withdraw in accordian-like movements. It is the presence of huge numbers which drives the guppy frantic and eventually kills him.

*Treatment: (1) For a slower, but effective cure, use formaldehyde. (2) For immediate curing use 3% ordinary (drugstore strength) hydrogen peroxide diluted with an equal amount of water.*

***Velvet.*** A few of these parasites on a fish appear as "ich".

It is when the infestation is heavy and the numbers of organisms together give a velvety appearance that the serious condition becomes apparent. Velvet is caused by a small yellowish organism called *Oodinium limneticum.* It has a whiplike flagellium to propel itself and another in a constriction in its middle.

On small fry velvet is particularly serious. The parasites have root-like tentacles which penetrate the fish's skin and through which they draw nourishment from the body. During only the free-swimming stage it is infective. As soon as it anchors itself, it starts to become pear-shaped; the constriction about its middle disappears, and it grows to be about eight times the size of the free-swimming form. After a few days feeding from the fish, it drops off and divides, as do its descendants, until it has become almost two-hundred of the free-swimming, infective forms.

*Treatment: (1) Acriflavin. (2) Methylene blue diluted as much as one-hundredth of a grain in a gallon of water, killed velvet, provided the temperature was maintained* from *77°–86°. (3) Mercurochrome. (4) Salt water. Do not remove the fish until all the adult forms have dropped off. These are the hard forms to kill; the infective free-swimming form is easily destroyed. (5) Probably simplest—12 copper cents in a gallon of water.*

***Leeches.*** In introducing pond water to tanks, one is quite likely to bring in a few leeches. These may be of many species. Some are harmless plant leeches. Others live in the gravel, come out and move rapidly about in the water, especially if disturbed. To most persons this species is obnoxious, yet they do not touch the guppies. In rare instances a young leech may be found attached to a guppy's side. They have been reported but we have never seen one.

*Treatment: To eliminate all kinds of leeches from a tank, clean it completely. New water, new gravel, new plants. Leeches are both male and female in the same individual and need no partner to populate an aquarium when only* *one is left. In pouring out the old water, take care to see that no leech has slid down under the rim made by the top angle iron, or it will drop back again into the water later on. Any sucking leech clinging to a guppy must be pulled loose with tweezers.*

***Fish Lice.*** This flat creature which lives on fish is a *Copepod* of which there are eight suborders, one of which is the *argulus* with twenty-two species found in America. The female louse lays from 30–200 eggs. The young must pass through eight transitions or stages before they become adult, a process requiring about eight weeks. Some are salt-water and some fresh-water forms. *A. versicalor* is prevalent in fresh water. It has two sucking discs, is about a sixteenth of an inch long. In outdoor pools it can destroy all the fishes.

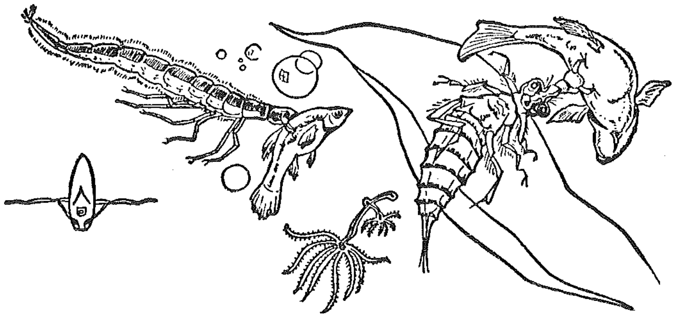
*Treatment: (1) Salt water cure. (2) Potassium permanganate added to the tank at the rate of one-fourth grain per gallon once a week for three weeks. (3) Pick lice off with tweezers and disinfect the spot.*

### ABNORMAL GROWTHS

Quite a wide variety of tumors appear on or in guppies. Some are benign, some malignant. Scientists are much interested in such growths but from a practical point of view, it is best to destroy affected fishes.

### ENEMIES

***Hydra.*** This little creature, anywhere from a third to one inch in length, is illustrative of how the guppy hobby carries us into related bypaths. Hydra are often introduced into aquaria with pond water and have become the "number one" enemies of guppies. To call them animals may seem like stretching a point if we judge from their appearance. A whole chapter could be written about them—here only the high spots. The animal attaches itself with a sticky substance to the glass or an object in the water. It cannot swim but it can move by a looping movement. The free end of the body has a conical projection called a *hypostome* on which its mouth is located. At its base is a circlet of long tentacles, five to ten in number. The hydra pulls the fry to its mouth by means of the tentacles, after interesting devices called *menatocysts* have caught it. Some of the menatocysts contain long spines in long rows. The prey is pierced and paralyzed by the spines which inject poison. Other cells have thread tubes in them which can lash out and wind around any protuberances on the fry to hold it securely, aided by a gluey substance which it secretes. In a daphnia culture hydra create havoc. Hydra, when at rest, contract into soft balls. After eating, too, they retract into irregular globular forms. Because they reproduce both by budding and by fertilized eggs, hydra breed very rapidly. They are difficult to eliminate from a tank by washing it or even drying because their eggs have a hard outer shell which resists both drying and washing. The contents of the shell come to life quickly once favorable conditions are established.

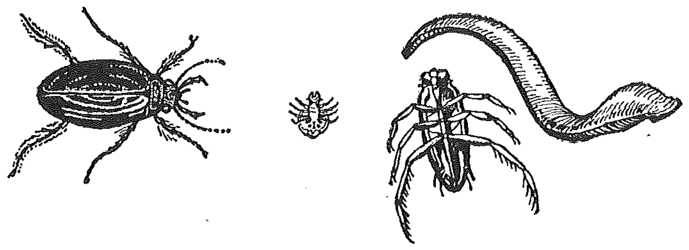


Guppy enemies: water boatman, larva of water beetle, hydra and dragon fly larva.

A heavy infestation of hydra can destroy or retard the growth of many fry both by killing them and by eating their food which starves them. Hydra are easily seen protruding from their attachments and swaying about.

*Treatment:* (*1*) *Hydra cannot stand chlorine or heat. If you have city water, remove the fish, drain tank and fill with* *fresh water. Return guppies two or three days later to the tank. (2) Remove fishes, raise water temperature to 105° for 24 hours. When the water has returned to normal, return the fish. (3) Use of ammonium nitrite or ammonium sulphate at the rate of 5 grains per gallon of water will destroy hydra. Dissolve crystals in small amount of water first, then pour this solution into the larger tank. In 3–5 days all hydra will be dead; the guppies remaining unharmed by the solution.*

***Insect Enemies.*** Almost all of the other guppy enemies are introduced unintentionally along with tubificids or daphnia and belong to the insect kingdom. Most of them are outdoor enemies, invading pools or large tanks in which the fishes are kept. There is no treatment for them but a mosquito screening over the tanks can do a lot to prevent the entrance of the insects. Here are the principal insect enemies:



Guppy enemies: water beetle, fish louse, back swimmer, leech.

Dragon fly larvae
Damsel fly larvae
Dobson fly larvae
Water scorpions
Water boatmen
Back swimmers
Water tigers, larvae of whirlgig beetles
Water scavenger's larvae
Predacious diving beetle larvae
Giant water bug

If you are not acquainted with these insects, read about them in a good insect book.

## CHAPTER VIII

# *Exhibiting Guppies*

THE NECESSARY BACKGROUND FOR A BEAUTIFUL specimen includes crystal-clear water, a dark green or black backdrop, lovely plants and proper lighting which should include a light with a reflector. It should be as close to the front glass as possible in order that the light may strike against the fish's body and reflect to the eye of the beholder.

***Water.*** The least murkiness in the water hides, to some extent, the exotic beauty of the fish. Should you carry fishes to an exhibition, be sure the water is clear. Of greater importance is the gravel—wash it until it can fall through the water and leave not the slightest trace of cloud.

***Plants.*** The darker the plants you can set, the better. A dark red cryptocoryne, some corkscrew vallisnaria are excellent.

### GUPPY VARIETIES

Herewith are the official standards of the British Guppy Breeders Society (in the absence of an American standard) in which there are nine recognized male and one female type:

**BRITISH GUPPY BREEDERS SOCIETY'S OFFICIAL STANDARDS** (Revised 1948)
Detailed Descriptions of all types of Show Guppies as sponsored by the Society and recognised by the F.B.A.S.

### TYPE

The following names of the varieties are based upon the finnage of the fishes:

***ROUNDTAIL.*** Caudal fin evenly rounded and free from any semblance of a point; dorsal fin comparatively short, tip rounded.

***SPEARTAIL.*** Caudal fin broad at base, tapering in a gradual curved sweep to form a symmetrical spear shaped point; dorsal fin of medium length, slightly curved and pointed extending to beyond the caudal peduncle.

***TOP SWORD.*** The uppermost rays of the caudal fin are extended to a single filament (sword) carried in a line with the body; dorsal fin long, straight and pointed, extending to the end of the caudal fin.

***BOTTOM SWORD.*** Same as above, but having a sword on the bottom of the caudal fin.

***DOUBLE SWORD.*** Caudal fin has two extending filaments which are spaced apart like >; dorsal same as top sword, but carried in a line with the upper extending tail filament.

***LYRETAIL.*** Caudal fin with two extending filaments somewhat similar to the double-sword, but not so long, and curved to resemble a lyre. The dorsal fin also slightly curved but not so long as that of the double-sword.

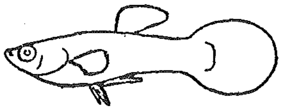
***COFER-TAIL.*** The rays of the caudal fin gradually extend to form a shape similar to a "Cofer" (South Wales Miner's Shovel) or the side half of an ace of diamonds; dorsal fin medium length, extending to but not beyond the caudal peduncle and pointed.

***ROBSON.*** Caudal fin evenly rounded, dorsal fin elongated, straight, pointed, extension well beyond caudal peduncle.

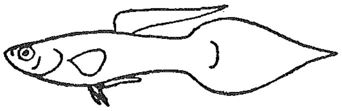
### COLOUR

***GREY.*** Male varied and brilliant colours on a dark grey background with dorsal and caudal fins brightly coloured. Female a dark steel grey, all fins may be streaked (not blotched or spotted like the coloured Females) with black.

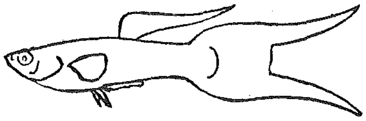
***GOLD.*** Male varied and brilliant colours on a Buttercup Yellow background with fins and dorsal brightly coloured. Female a clear



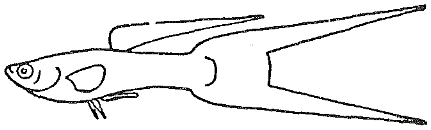
ROUNDTAIL



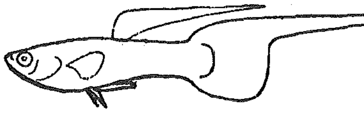
SPEARTAIL



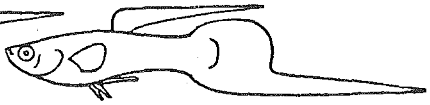
LYRETAIL



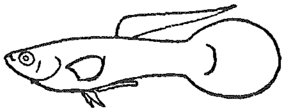
DOUBLESWORD



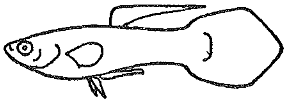
TOPSWORD



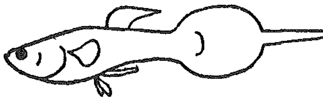
BOTTOMSWORD



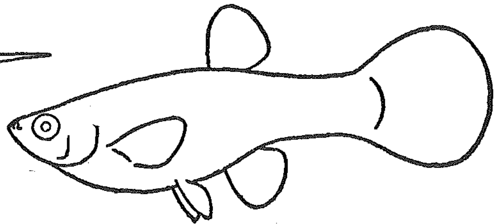
ROBSON



COFERTAIL



PINTAIL



FEMALE

Buttercup Yellow, body colour may diffuse into the dorsal and caudal fins.

***GOLDLACED.*** Male varied and brilliant colours on a golden brown background, each scale edged with black; dorsal and caudal fins brightly coloured. Female a rich golden brown, each scale edged with black; all fins may be streaked with black.

***ROBSON.*** Male varied and brilliant colours on a dark grey background; dorsal and caudal fins brightly coloured. Whilst the dorsal and caudal fins may be black, such is not desired. Female a dark steel grey with a black tail and dorsal fin.

***COFER-TAIL.*** Male varied and brilliant colours on a background of any one colour, with dorsal and caudal fins brightly coloured. Female colour to match male with dorsal and caudal fins blotched or spotted with as may varied colours as possible.

***SELF.*** Male body of any one colour with dorsal and caudal fins of a different colour or colours. Female body colour to match male.

The above mentioned varieties may appear in combination with any of the colours previously listed with the exception of the Robson (Male and Female).

***MALES OF ALL TYPES.*** Length from tip of nose to end of caudal peduncle one and one-eighth inches (i.e. diameter of a [British] penny).

*Body and Head* shaped as sketch, greatest depth one-fourth of the length.

*Dorsal Fin* well developed, erect, shaped according to variety specified.

*Caudal Fin* well spread, shaped according to variety specified.

*Pectoral and Pelvic* fins evenly developed.

***FEMALES OF ALL TYPES.*** Length from tip of nose to end of peduncle 2 inches.

*Body and Head* shaped as sketch.

*Dorsal Fin* fan shaped and well spread.

*Caudal Fin* large, rounded and well spread.

*Anal Fin* similar to dorsal.

*Pectoral and Pelvic* evenly developed.

## SHOW POINTS

### NEW POINTING FOR MALE AND FEMALE GUPPIES

| | | | |
|---|---|---|---|
| BODY | 20 | Shape | 10 |
| | | Size | 10 |
| CAUDAL FIN | 20 | Shape | 10 |
| | | Size | 10 |
| DORSAL FIN | 20 | Shape | 10 |
| | | Size | 10 |

| | | | |
|---|---|---|---|
| CONDITION AND DEPORTMENT | 20 | Condition | 10 |
| | | Deportment | 10 |
| COLOUR | 20 | Caudal Fin | 5 |
| | | Dorsal Fin | 5 |
| | | Body | 5 |
| | | Intensity | 5 |

N.B. Condition is soundness of body and fin; Deportment is carriage and behaviour.

Great importance, from a breeding point of view, is placed on the colour of the Female, and for that reason an equal number of points to those of the Male have been allotted for colour. This also greatly assists the judge in arriving at a decision, seeing that all females, unlike the males, can be so much alike in other aspects.

## PAIRS

The showing of Guppies in pairs is not recommended by the Society for the following reasons:

(1) The exact similarity in appearance of all varieties of females (Cofer and Robson excepted) makes it impossible to say if they are really a pair of the same variety.
(2) The difference in the points allotted.
(3) The vitality of the male makes the practice inadvisable from a breeders point of view.

## JUDGING GUPPIES

The Official and Accepted Basis for the Guidance of Judges.

Owing to their diminutive size, vivacity and the number of different varieties involved and the similarity of all the females (apart from the coloured varieties which differ only in colour) judging of Guppies is complex.

The Importance of Type.

Since all the different varieties of male Guppies sponsored by the G.B.S. are identified and named after the shape of their tail formations (except Robson) the tail is the first and foremost characteristic to be considered when judging. The second consideration is their dorsal fin. Colour is also very important but a highly coloured fish failing in type must be superseded by one not so well coloured but of the correct type (tail and dorsal fin formation).

A male with a brightly coloured body but having dull or colourless fins must be superseded by one having a body less colourful but having brightly coloured fins. All things being equal "a good big 'un will always beat a good little 'un."

The females of all varieties being of the same type, judging the ordinary or plain female is difficult. Colour (body), condition (shape and vigour) and size in combination is the ideal.

With the coloured females it is easier. They should be judged on colour first as this is their chief characteristic. A female with coloured tail and dorsal fin is preferred to one with only a coloured tail *or* dorsal fin. A female with brightly coloured fins supersedes one with dull coloured fins. Multiple coloured fins are preferable to a plain or one coloured.

Various bright colours in the form of a pattern are the idea (apart from Robsons which should have a dense black tail and dorsal fin on a grey body). The best of the above should be considered before the qualities referred to, regarding ordinary females.

Females, if shown in young, should be severely penalised. Apart from the distorted shape of their body there is always the risk of losing the female through the discomfort occasioned when in this condition or through the dropping of her brood, the exhibitor thereby being disqualified through having too many fish in the jar or tank.

It becomes apparent at once to an American breeder that the list is far from complete; that other types must be added to please the fancy, for example:

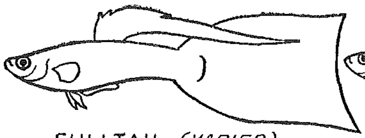
***Narrow Veiltail***—a long sweeping tail with parallel top and bottom. End of tail must be square across, not split or ragged.

***Wide Veiltail***—must have tail with parallel top and bottom but as wide as possible. Judged on width as well as color.

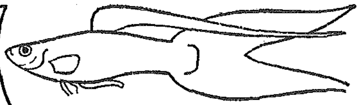
***Triangle Tail***—starting from body, the tail flares out to make as nearly as possible an equilateral triangle.

***Swallowtail***—a triangle, with flaring sides and a V-shaped end of tail.

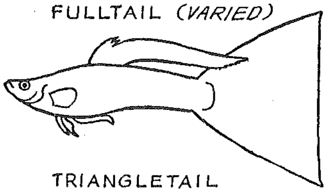
We need a standard for female types. The guppy will progress much faster as a fish of beauty as the females become more colorful, and develop points of difference. The females in color show some of those existing differences. Mutations are always occurring which could be incorporated and bred true, even in the wild type. Black tails have frequently appeared in females, oddly shaped fins, both dorsal and caudal. One strain has been developed in which both males and females possess a bluish tone over the whole body like that commonly seen in blue platys.



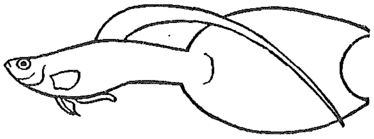
FULLTAIL (VARIED)



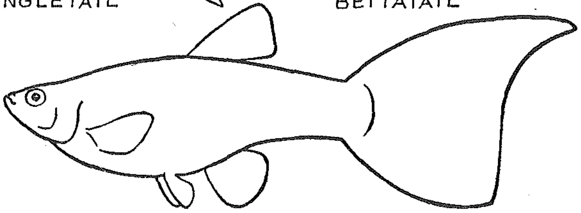
SCISSORTAIL



TRIANGLETAIL



BETTATAIL



BIGTAIL FEMALE

In the British standard, there is no encouragement for development. There is a great difference between a *standard* which imposes limits, and an *ideal* which is a target at which we are shooting. The former prescribes limits; the latter beckons us to greater achievement through the utilization of mutations. In some future standard let us hope that the conception of an ideal will be basic. I hope when the American standard is set—and it should be soon—it will take creative genius into consideration.

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